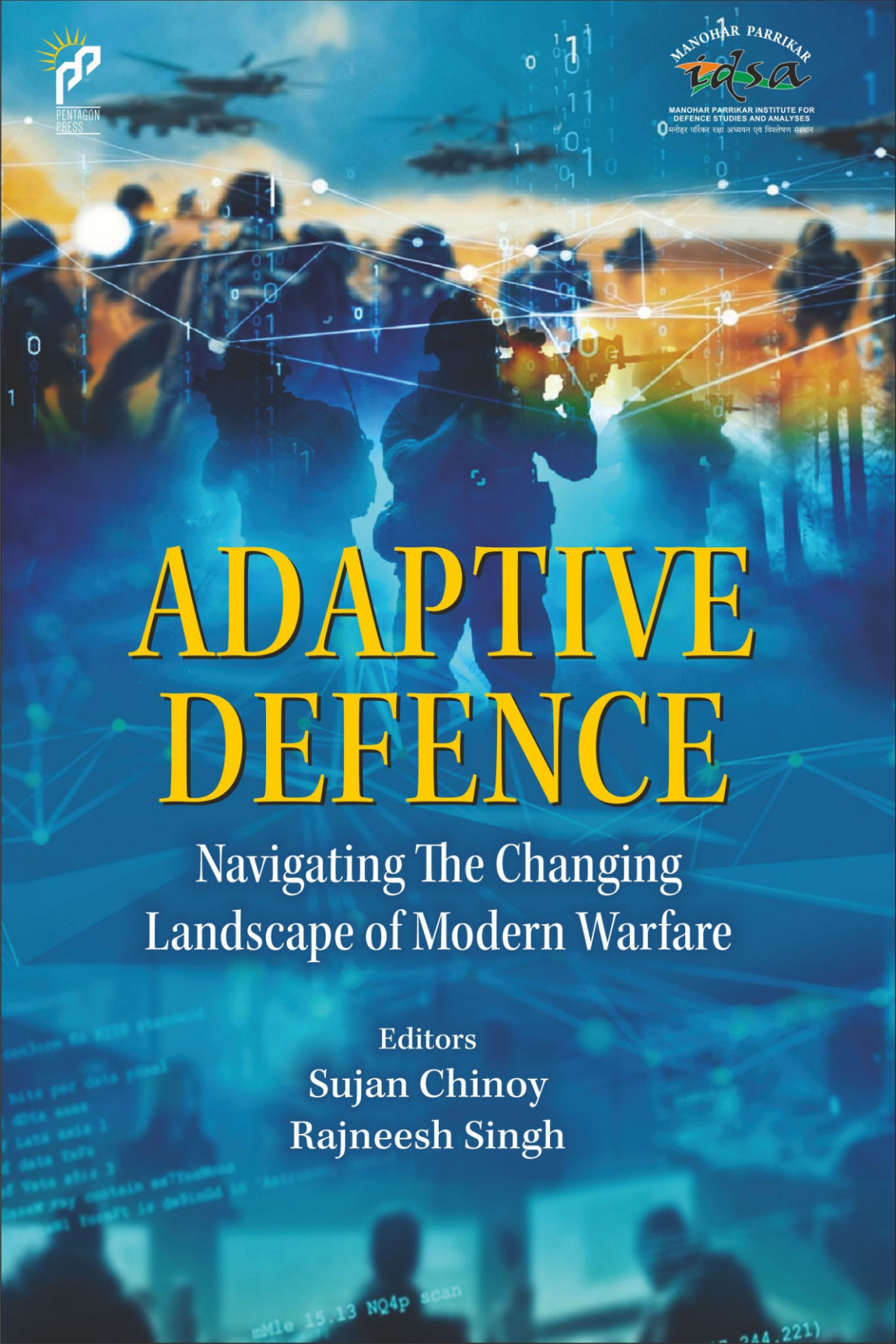
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ADAPTIVE DEFENCE
Navigating The Changing Landscape of Modern Warfare
Editors
Sujan Chinoy
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Contents

Acknowledgements *ix*

List of Contributors *xi*

1. Introduction 1
Sujan Chinoy

PART I
Full Spectrum Threats: Challenges of Changing Character of Warfare

2. Conventional Wars Reassessed: Great Power Competition and New Age Technologies 21
Rajneesh Singh

3. From Territory to External Operations to Statecraft to Adaptability: Main Trends in Jihadist Militancy 33
Riccardo Valle

4. Nuclear Deterrence in the Age of Major Power Conflict 52
D B Venkatesh Varma

PART II
Organisational Agility: Meeting the Challenges of Modern Wars

5. Organisational Agility: Jointness a Necessity for Modern Warfare 61
Rajeev Sachdeva

6. Framework for Enhancing Jointness in the Armed Forces 71
Vivek Chadha

7. Size vs. Technology in Modern Armies: A Dance for Agility 87
Rajeev Sabherwal

8. Resourcing Military Capability Development and Effectiveness 106
Samir Gupta

PART III

Navigating Domains of Wars: Addressing Operational and Administrative Challenges

9. Adaptive Defence: Operational and Administrative Challenges in Changing Maritime Warfare 117
S N Ghormade

10. Command Intuition and Battlefield Effectiveness: From the Peloponnesian War to the Russo-Ukrainian War 126
Pascal Vennesson

PART IV

Age of Disruption: Transformative Technologies in Modern Wars

11. Law and Ethics in the Governance of AI-enabled Military Systems 141
Rain Liivoja

12. Autonomous Robotic Systems in the Transformation of Modern Warfare 153
Artsrun Hovhannisyan

13. The Evolving Landscape of Air and Missile Threat: A Defender's Perspective 160
Uzi Rubin

PART V
Strategic Partnerships: Enhancing National Security through Collaboration

14. Collective Security in (Eur)Asia: Views from Moscow and from New Delhi 179
Andrey Kortunov

15. Enhancing National Security through Collaboration: The EU–India Strategic Partnership 193
Frédéric Grare

16. Changing Trends in India–Israel Defence Equation: The Iron Swords War 203
Oshrit Birvadker

PART VI
Policy Perspectives: Advancing Domestic R&D Capacity in Defence

17. India's Defence Aeronautics R&D Trajectory in 2025 221
Rajiv Kumar Narang

18. Private Industry R&D in Defence Sector 241
Ashis Bhattacharyya

19. Advancing Domestic R&D Capacity in Defence: Role of Academia 251
Nabanita Radhakrishnan

PART VII
Protracted Wars and Sanctions: Mitigating Risks in Defence Resource Management

20. Navigating Protracted Wars and Sanctions: Mitigating Risks in Defence Production 265
Jayant Patil

21. Navigating Protracted Wars and Sanctions: Mitigating Risks in Defence Resource Management 277
Abhay Dayal

22. Defence Production and R&D in India: Adapting to Externalities 289
Rajinder Singh Bhatia and Dnyanada Palkar

23. Collaboration with Foreign Partners for Self-reliance 301
Amit Cowshish

24. Logistics in the Times of Protracted Conventional Wars Under the Shadow of Sanctions and Export Control Regimes: Japan's Perspective 311
Sadamasa OUE

Index 324

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We would like to acknowledge the tireless efforts of the organising committee of the DDD, whose planning and coordination made the event a success and laid the groundwork for this publication.

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Sujan Chinoy & Rajneesh Singh

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1

Introduction

Sujan Chinoy

In an era defined by geopolitical uncertainty and rapid technological advancement, the landscape of warfare and those aspects that facilitate and sustain countries at war, namely, defence industrial complex and resilience of supply chains, are undergoing profound transformations. Traditional notions of war are being reshaped by emerging technologies, evolving strategic partnerships and constantly shifting organisational dynamics within the armed forces, resulting in newer doctrines and concept of operations.

The post-Cold War era which began in the early 1990s with a vision for global peace is nearing its end. Currently, the geostrategic landscape is marred by wars, regional conflicts and terrorism hotspots. The world, today, countenances the highest numbers of military conflicts and flashpoints since the Cold War, casting an adverse impact on international relations in every continent. Europe is experiencing one of the most devastating wars in a very long time. The brutal Israel–Hamas war is escalating instability in West Asia with the potential to create a deeper wedge between various adversarial powers and among security partners. The threat of the war in West Asia expanding remains real, with other regional actors and radical groups joining the fray with potent low-cost weapons and innovative battlefield practices. East Asia, even though not at war, has its share of geopolitical challenges occasioned by China's assertive behaviour, with grave consequences to world peace and stability.

The exit of United States (US) from Afghanistan signalled a turning point in the US-led Global War on Terror, from direct intervention to the use of high-tech

stand-off capabilities to counter terrorism. The emergence of a large-scale protracted conventional war in Europe today involves state actors, such as in the ongoing Russia–Ukraine war. In West Asia, the conflict involves the Israel Defense Forces and a radical organisation-cum-quasi-state actor, Hamas. The involvement of non-state and quasi-state belligerents has introduced unprecedented levels of complexity, especially when the latter possess territory and command influence in the local populace with seamless transitions between combatants and civilians. The Armenia–Azerbaijan war also holds significant lessons for militaries around the world, especially the effective use of armed drones, which are now de rigueur in terms of their widespread deployment from the battlefields in Ukraine to the Houthi-dominated waterways of the Red Sea. Such reorientation is forcing militaries everywhere to reassess priorities and strategies, particularly from counterterrorism-focused operations to conventional wars. During this period, India has witnessed a considerable decline in terrorism-related incidents in the union territory of Jammu and Kashmir. In light of China's aggressive posture, India has renewed focus on building conventional capabilities, especially in the aftermath of the military stand-off with China since 2020.

To get a holistic perspective, the changing character of warfare must be examined across all the four domains: air and aerospace; land; maritime; and cyberspace. Each domain presents unique opportunities and challenges, necessitating a nuanced understanding of strategic imperatives and operational dynamics. The examination of these domains will provide an understanding of the evolving contours of contemporary warfare and identify strategies that will guide future approaches to national security.

It is likely that conventional wars in the future may be fought on a greater scale, higher intensity and across a wider geography when compared to most of the recent conflicts and terrorism-related operations. They may involve state and quasi-state actors. They will require unprecedented mobilisation of resources, large-scale manoeuvres involving infantry and armoured formations, employment of missiles and emerging and disruptive technologies as well as the use of space-based assets. The military strikes will blur the distinction between civilian and military targets and test the resilience of the national economy, society and military. The prolonged wars, made worse by the inability of a divided United Nations Security Council to reach consensus on issues of war and peace, will place a premium on the country's defence preparedness, especially in terms of the resilience of its defence industrial base, research and development (R&D), the innovation ecosystem and resolute political will.

The emergence of a new kind of conventional war does not settle the challenges posed by other forms of warfare, for example, multi-domain warfare, irregular warfare, grey zone activities and hybrid wars. Nuclear, biological and chemical weapons continue to pose significant threats to global security and stability due to their potential for mass destruction, indiscriminate impact and ability to cause widespread fear and disruption. Each category of weapons of mass destruction (WMD) presents unique risks and challenges. Sub-conventional and WMD threats will continue to remain potent challenges and will require continued fulsome attention of the political, military and scientific leadership.

However, the evolution in warfare is not limited to technological advancements alone. Organisational structures and operational frameworks within the armed forces also play a pivotal role in shaping military effectiveness. It is important to explore the organisational challenges faced by the armed forces. The creation of joint structures and warfighting doctrines involving the three services and integrating the services with various departments of the Ministry of Defence (MoD) and other branches of the government are among the key considerations in optimising military effectiveness. The perennial debate about striking the right balance between the need to introduce and absorb emerging and disruptive technologies and right-size the armed forces underscores the importance of adequate budgetary allocation. The analysis of these organisational dynamics provides insights into optimising the capabilities of the armed forces to deal with contemporary exigencies and to remain in readiness for the battlefield of the future.

Conventional and other forms of wars involve a complex operational environment and are fought over land, sea, air and cyber domains. Each domain has its own unique challenges and provides opportunities in the pursuit of military objectives.

The impact of rapidly evolving technologies on modern warfare cannot be underestimated. The combined power of computers, data and connectivity is shaping the contours of the battlefield today. In the information age, the perception of the world is being manipulated at an extraordinary pace and in previously unimaginable ways, including through misinformation that blurs the distinction between fact, opinion and fiction. Smartphones, Internet and social media are connecting people and in this space, opinions matter more than well-researched understanding of various issues. Unverifiable assertions are attracting the attention of 'true believers', sceptics and conspiracy theorists; and in the times to come, the issue will become even more complex with the maturing of artificial intelligence

(AI). Today, information is not an enabler but an instrument of power to be used at strategic, operational and tactical levels of warfare to dominate the adversary. If used in a coherent and planned manner, information warfare can generate potent advantages over the adversary through its mass effect, especially in building national consensus.

Emerging and disruptive technologies are revolutionising modern-day warfare. Artificial intelligence and cyber issues, missiles and air defence systems, unmanned systems and dual-use systems are among the disruptive technologies transforming modern-day warfare. They have the potential to shape the future of warfighting. These technologies provide unparalleled and unique capabilities, while presenting new challenges in terms of operational vulnerabilities and ethical dilemmas.

The recent wars have many lessons for the policymakers and the military leadership. There is a tendency to excessively focus on cutting-edge technology for force generation to offset the reduction in budgets for recruitment, training and maintaining human resources. What is the right balance regarding these divergent requirements in order to optimise the required capabilities is an answer that is actively sought by academics and practitioners alike.

In addition to organisational reforms and absorption of emerging and disruptive technologies, strategic partnerships play a decisive role in reinforcing national security and shaping defence strategies. India has many strategic partners and collaborates on various defence-related issues with the US, Russia, France, Australia, Japan, South Korea and Israel, among others. Assessing the nuances of these partnerships is essential for bolstering diplomatic relations and enhancing the security posture of the country. Strategic partnerships between countries play a vital role in reinforcing national security and shaping defence strategies by enhancing military capabilities; extending geographic reach; promoting intelligence sharing and coordination; facilitating technology transfer and collaboration; providing diplomatic and political support; generating economic and trade benefits; and enabling effective crisis response and humanitarian assistance operations.

Overall, while strategic partnerships offer opportunities for enhanced security and cooperation, they are also vulnerable to a range of factors that can negatively impact their effectiveness. Factors that require constant attention of policymakers include: the shifting geopolitical dynamics; divergent national interests; historical baggage and trust deficit; economic disparities; power asymmetries; legal and political constraints about episodic incidents; and external pressures and

interference. These can impact adversely on the best of strategic partnerships and, in turn, can cast a shadow on high-tech cooperation in defence technologies and procurements. Overcoming these challenges requires sustained diplomatic engagement, mutual trust building and a shared commitment to addressing common security threats and challenges in a rapidly evolving global landscape.

By forging strong partnerships with like-minded countries, nations can enhance their security, resilience and ability to address complex and evolving challenges of the twenty-first century.

The recent wars are providing countries with fresh concepts and new logic to bring about a transformation in their armed forces and defence industrial base. Parties involved in protracted wars are heavily reliant on foreign sources for supply of war-related equipment and stores. Russia, for instance, is hemmed in due to the sanctions imposed by the US and its allies and partners. It is under these conditions that belligerents are constrained to endure with war. This holds lessons for other countries with regards to self-reliance in defence production and supply chain management.

New and emerging technologies and material resources are closely guarded by those who possess them. As a result, there will always be a certain level of dependency on other countries. One way of obviating such challenges involves defence industrial collaboration with trusted partners. Industrial collaborative frameworks across diverse regions serve as a pivot in fortifying national security capacities. From East Asia to West Asia, Southeast Asia to Africa and Europe to the US, collaborative endeavours in defence production are instrumental in enhancing indigenous defence capabilities and fostering technological self-reliance. These are essential in order to make India's defence industrial base, particularly indigenous products, a part of global supply chains.

The defence R&D and innovation ecosystem has multiple stakeholders, such as higher education institutions, R&D organisations, funding agencies, regulatory bodies, business enterprises and the three services. An understanding of the existing ecosystem, policies, regulations and trade agreements will advance the cause of R&D capacity building and strengthen the interlinkages between various stakeholders at national, sub-national and sectoral levels.

Against this backdrop, the Manohar Parrikar Institute for Defence Studies and Analyses (MP-IDSA) organised the inaugural edition of the Delhi Defence Dialogue (DDD), on 12–13 November 2024. The aim was to gain deeper insights into the complexities of modern defence landscape and the intricate layers of

contemporary warfare, which will help formulate strategic approaches to address the challenges of India's security in the evolving Asian and larger global security environment.

The sessions in the DDD sought to address the following research questions:

- How is the character of modern warfare evolving and what is its impact on the doctrines and operations of the armed forces?
- What are the organisational challenges faced by the armed forces in furtherance of politico-military objectives of wars and operations?
- How are the domains of war being impacted by the changing character of warfare?
- How is technology impacting the preparation and execution of war?
- How can strategic partnerships promote India's defence security?
- How can India become *atmanirbhar* or self-reliant in defence?
- How can Indian entities create intellectual property for global requirements through indigenous R&D?

Based on the conference theme, the book chapters address various aspects of the changing character of warfare.

Rajneesh Singh, in his chapter, 'Conventional Wars Reassessed: In Times of Great Power Competition and New Age Technologies', examines the evolving nature of warfare in the context of shifting international power dynamics, particularly the rise of China and its implications for the US and Western-led international order. Historical precedents suggest that great power competition often led to irregular conflicts. The same is evident in the increasing prominence of sub-conventional warfare—multi-domain, grey zone, hybrid warfare—since 2014. These forms of conflict represent a strategic adaptation to the complexities of contemporary geopolitics, where direct military confrontation is often avoided in favour of more ambiguous engagements. The ongoing war in Ukraine serves as a critical case study, illustrating a return to large-scale conventional warfare characterised by significant military manoeuvres and state-to-state confrontation. This war underscores the potential for escalation in traditional military engagements and highlights the challenges of protracted wars in the shadow of sanctions and export control regimes. The chapter also deliberates on the ways in which advancements in military and dual-use technologies are transforming the way wars are being fought and the need for military leadership to integrate new technologies for operations and developing military capabilities to counter emerging threats.

Riccardo Valle, in his chapter, 'From Territory to External Operations to Statecraft to Adaptability: Main Trends in Jihadist Militancy', examines the increasing challenge posed by non-state actors to nation states and regional/international alliances worldwide, making it difficult to dissect the ongoing patterns in the sphere of jihadist militancy. Some of the main trends witnessed in the last five years include establishment of jihadist proto-states, along with renewed calls for a disseminated and dispersed global jihad. In South Asia, the return of the Afghan Taliban to power translates into both opportunities and challenges for other jihadist entities, which are already taking advantage of the situation. The chapter examines four main trends experienced by jihadist organisations, highlighting that the world might be experiencing a transitory phase in the environment of jihadist militancy.

In the next chapter, 'Nuclear Deterrence in the Age of Major Power Conflict', D.B. Venkatesh Varma dwells on the Ukraine conflict as reflective of the intense geopolitical competition between the big powers—Russia and the US—the changing nature of warfare, the role of technology and the evolving nature of doctrine and strategy. He argues that unlike in the Cold War period, conventional escalation is occurring in the present times despite presence of nuclear weapons, thus eroding its core deterrent value. This may have serious consequences for escalation dynamics and doctrinal planning for all nuclear powers. Its negative demonstrative effect on certain countries, like Pakistan, China or Democratic People's Republic of Korea, may increase nuclear risks in the coming years. Continuing biological and chemical weapon threats and the impact of new technologies, such as AI, are emerging game changers. He suggests that it is important to study these developments to see how best the Indian Armed Forces can adjust to the new battlefield environments, as also India's response at international forums to address these security challenges.

Creation of the post of the Chief of Defence Staff (CDS) and the Department of Military Affairs (DMA) was a historical moment for the Indian Armed Forces and has amalgamated the Indian military into a national security mechanism. In 'Organisational Agility: Jointness a Necessity for Modern Warfare', Rajeev Sachdeva highlights that the Government of India, as of 1 January 2020, carved out Allocation of Business Rules for the Secretary DMA and tasked the CDS to restructure the military organisation and create theatre commands. Sachdeva argues for the whole-of-nation approach for the three services for: creating an interoperable environment; fusion of intelligence; building a common battlefield milieu; seamless connectivity; a joint perspective plan; and creation of a joint capability, with

common cyber, mobility, space, logistics, communication, networking, training, maintenance, intelligence, surveillance, air defence, capability building, acquisition, military diplomacy, common human resource issues, common legal act, disaster management, AI, drones milking, information sharing and codification.

In his chapter, 'Framework for Enhancing Jointness in the Armed Forces', Vivek Chadha informs that there has been a long-standing debate over attempts to enhance jointness within the Indian Armed Forces. The experience of militaries worldwide suggests that the process is more complex than merely creating integrated structures. He analyses India's experience to enhance jointness based on previous wars and recommends a framework for enhancing jointness based on the lessons from the country's military engagements.

Modern warfare is evolving rapidly due to technological advancements and a shifting global security environment. Rajeev Sabherwal's 'Size vs Technology in Modern Armies: A Dance for Agility' critically examines the ongoing debate on the optimal approach to structuring the Indian Armed Forces, focusing on the balance between a technology-centric and size-centric approach. The study contrasts the benefits and limitations of both approaches: the technology-centric strategy, which emphasises cutting-edge innovations; and the size-centric strategy, which relies on traditional manpower and larger force structures. By analysing lessons learned from other nations that have faced similar strategic choices, the chapter offers a comparative perspective on how these differing strategies have impacted military effectiveness globally. The findings underscore the importance of not exclusively favouring one approach over the other, but rather adopting a balanced strategy that integrates advanced technology with adequate force size. This balance is crucial for ensuring that the Indian Armed Forces remain versatile, resilient and capable of addressing a wide range of threats. The chapter concludes with recommendations for achieving this balance, aligning India's military capabilities with its broader national security objectives and drawing on the experiences of other nations to implement these decisions.

There is a lively debate in the country regarding the pace of growth of the defence budget and surrender of capital funds by the MoD in recent years. Samir Gupta, in his chapter, 'Resourcing for Military Capability Development and Effectiveness', argues that resourcing of the capital budget should not be viewed in isolation as the primary driver of modernisation and improvement of military effectiveness. While it is a fact that a lot has been done to improve military capabilities, there is a need to identify measures to enhance military effectiveness in view of the latest advancements in military technology. The author recommends

that there is a need to rethink utilisation of funds to fight a possible protracted war. The need of the time is to adopt a holistic approach across ministries, break barriers and artificial boundaries, as also develop mental and organisational agility to ensure appropriate funding and policy facilitation. The overarching aim should be to identify and open bottlenecks in development of the desired qualitative edge and military effectiveness essential for security and self-reliance.

The character of modern warfare is evolving because of technological advancements and complex geopolitical dynamics, necessitating a continuous shift in military doctrines and operations. The chapter, 'Adaptive Defence: Addressing Operational and Administrative Challenges in Maritime Warfare', by S.N. Ghormade highlights organisational challenges and the need for inter-service coordination and adaptive strategies to achieve politico-military objectives. As warfare increasingly spans multiple domains, particularly maritime, the integration of advanced technologies and cyber capabilities shapes operational frameworks and power dynamics at sea. The new and emerging technologies, while significantly influencing the preparation and execution of military operations, also introduce new vulnerabilities. In this milieu, innovative strategy and tactics will continue to play an important role in maritime warfare. Strategic partnerships are also vital for India's defence security, enabling access to advanced technologies and collaborative training. To achieve *atmanirbharta*, India must focus on strengthening indigenous defence manufacturing and fostering innovation in R&D. By prioritising home-grown solutions, Indian entities can create intellectual property that addresses global defence needs, positioning India as a key player in the international defence landscape. Ghormade goes on to recommend that an adaptive defence strategy that embraces technological, organisational, innovative and collaborative advancements is essential for addressing the challenges of maritime warfare in the modern era and bringing in the necessary agility and responsiveness.

Pascal Vennesson's chapter, 'When Generals Matter: Strategic Intuition and Military Effectiveness in Land Warfare', is a study of intuition as a function of military effectiveness. Generalship is a core dimension of land warfare, but its relative importance for military effectiveness is theoretically contested and empirically unresolved. In fact, cognitive psychologists themselves disagree about whether expert intuition should be trusted. The heuristics and biases research tradition, initiated by Daniel Kahneman and Amos Tversky, commonly favours a sceptical attitude towards expert judgement. By contrast, the naturalistic decision-making research tradition, advanced notably by Gary Klein, offers a generally encouraging picture of expert performance. Building upon key insights from the

cognitive psychology of expert intuition, Vennesson sets out the strategic intuition theory of military effectiveness. The theory highlights three conditions for generals' expert intuition to increase military effectiveness: their situationally relevant experience; the stability of central features of their operational environment (enemy and geography); and their opportunity to adapt to that operational environment through learning and innovation. The chapter provides a preliminary empirical assessment of the theory by examining key command decisions in land warfare during World War II and the Russia–Ukraine war.

Technologically advanced armed forces are rapidly fielding autonomous and AI-enabled systems. Uncertainties around the regulation of such systems, however, have preoccupied the international community for many years. The need for new governance frameworks for autonomous weapon systems has been debated for a decade under the auspices of the Convention for Certain Conventional Weapons and, more recently, the United Nations General Assembly. In recent years, a somewhat separate discussion has turned to the responsible use of military AI more broadly. In various forums, states have identified a range of relevant normative issues and articulated several ethical principles. Rain Liivoja's chapter, 'Law and Ethics in the Governance of Autonomous and AI-enabled Weapon Systems', gives an overview of autonomous and AI-enabled weapon technologies and the disparate governance debates that surround them. It, then, focuses on the rather confusing relationship between ethics and law in this context. Not only is the need for ethical compliance sometimes identified as a legal requirement, but legal compliance is sometimes mentioned as one of the ethical principles. This chapter considers to what extent the proposed ethical principles reflect, or derive from, existing law and to what extent they might be able to guide new international law.

Artsrun Hovhannisyan's chapter, 'Autonomous Robotic Systems in the Transformation of Modern Warfare', studies how unmanned systems and robots are transforming modern wars. In recent times, profound changes in military science and technological developments are manifesting in conflicts, both large and small. Post-Cold War technologies, such as the first generations of precision weapons guided solely by satellite systems, face significant challenges today as they can be easily suppressed by means of remote weapons. New technologies are advancing rapidly. The unmanned aerial vehicles (UAVs) are among these revolutionary solutions; they rival cruise missiles in range, are cost-effective and often compact. First-person view drones already complement many anti-tank systems. While aerial unmanned systems have already proven their effectiveness and potential, ground robotic systems are relatively new in military affairs. They

are just beginning to define their role but hold considerable promise. Ground robotic autonomous systems can fundamentally change ground combat dynamics, enabling faster action with fewer casualties. These concepts require further refinement and development, but Hovhannisyan believes they hold significant promise. Integrating robotic systems of all sizes and clearly defining human roles in these matters will be a critical agenda item in future warfare.

Until the second half of the nineteenth century, war was fought in two dimensions. The invention of flying machines added a third dimension and introduced the air threats—which, in turn, triggered the development of air-based and ground-based air defences. Vertical threats became even more complex once the ballistic missile was invented. This, in turn, triggered the development of ballistic missile defences. Later, the march of technology created the precision unmanned jet aircraft, alias cruise missile. Almost simultaneously, the operational requirement for low-cost, survivable, 'beyond the hill' reconnaissance systems brought forth the relatively cheap, low and slow uncrewed air vehicles. Each of these four families of weapons, that is, manned aircraft, ballistic missiles, cruise missiles and uncrewed air vehicles, required tailored defensive systems, which have been developed over time. Uzi Rubin's chapter, 'The Evolving Air and Missile Threat: Defender's Perspective', studies the distinction between those four domains which is fast blurring out. Instead of four well-delineated domains, the defender is now facing a continuum of threats from low and slow to high and fast. The classic air and missile defence systems are inadequate against the new aggressor technologies. The author recommends several avenues to be explored, the main one being overturning the cost exchange ratio at the margin: make the cost of defence lower than the cost of offence. Overturning the cost exchange ratio is a major technical challenge, and the defenders are not there yet.

In the next chapter, 'Collective Security in (Eur)Asia: Views from Moscow and from New Delhi', Andrey Kortunov tries to compare Russian and Indian contemporary approaches to the concept of collective security in Asia, keeping in mind not only common or converging but also overlapping and clearly divergent views coming from Moscow and from New Delhi. In particular, the chapter addresses how, in Russia and India, they define national threat perceptions, potential participants to the Asian security system, its geographical scope, the preferred legal arrangements for the system and interconnections between security and development. Kortunov concludes that existing differences in Russian and Indian approaches to continental security, as important as they are, should not prevent the two nations from working together in both bilateral and multilateral

formats on many practical security matters in Asia. The two nations can also learn a lot from each other. Russia can share with India its diverse experience in global politics, including in such critical areas as strategic stability, arms control and international crisis management in remote parts of the world, while India can offer Russia its experience in building a friendly neighbourhood, in well-calibrated 'zone balancing' and, above all, in exercising appropriate 'strategic patience' when dealing with existential security challenges.

Frédéric Grare's chapter, 'Enhancing National Security through Collaboration: The EU–India Strategic Partnership', deals with strategic partnership between the European Union (EU) and India. Although the partnership dates back to the Hague Summit in 2004, it took a long time for it to include a significant security dimension. Individual EU member states did cooperate with India in defence production and exercised with its armed forces, but even when involved in the same theatres, like in Afghanistan, the EU member states and India hardly consulted each other, even less coordinated their activities. The EU was—and to some extent still is—seen in India as a supranational organisation that is struggling to form a common front on military and defence activities. The situation is evolving today for certain reasons: the weaponisation of all activities by China, blurring the lines between traditional and non-traditional threats, and the consequent emergence of grey zones; the EU's willingness to address these issues; and the elaboration of an EU Indo-Pacific strategy. The EU's intent to focus on non-traditional and hybrid threats, much more in line with the capacities it is capable of and willing to devote to the Indo-Pacific, opens potentially a vast field of cooperation in a space where neither of the two entities has the capacity to act alone.

Since 7 October 2023, Israel has encountered significant delays in arms shipments and has faced the looming threat of an arms embargo from Western countries, marking a notable shift in international support. Even the US, Israel's principal ally, has leveraged military aid as a policy tool, raising concerns within Israel regarding its reliance on American military assistance and the consequences for its national autonomy. The conditional nature of this aid has brought into question Israel's capacity to maintain an independent foreign policy, complicating its ability to address emerging security threats. Given these challenges, India's growing capabilities in the defence sector present a strategic alternative to Israel's traditional dependence on Western arms, offering a potential counterbalance in a time of geopolitical uncertainty. Oshrit Birvadker, in 'The Changing Trends in India–Israel Defence Equation: The Iron Swords War', explores the imperative

for Israel to build new supply chains with India, spanning from essential munitions, like dumb bombs, to advanced guided weaponry, to enhance its military self-sufficiency.

Indian aeronautics manufacturing industry appears promising in 2025 as it is pursuing several indigenous manned and unmanned aeronautics development programmes. These include Light Combat Aircraft Mark-1 (LCA Mk-1), LCA Mk-1A, LCA Mk-II, LCA Navy Mk-1A, Advanced Medium Combat Aircraft (AMCA), Twin Engine Deck Based Fighter (TEDBF), Kaveri aero-engine, Tapas medium-altitude long-endurance (MALE) UAVs, Remotely Piloted Strike Aircraft (RPSA), Combat Aerial Teaming System (CATS), etc. All these programmes have their own nuances, challenges, limitations and opportunities. In the chapter, 'India's Defence Aeronautics R&D Trajectory in 2025', R.K. Narang makes an endeavour to provide a brief overview of the trajectory and challenges of indigenous aero-engines, manned and unmanned aeronautics development programmes being pursued in 2025 and proposes a way forward to achieve self-reliance.

Ashis Bhattacharyya's chapter, 'Private Defence Industry R&D in Defence Sector', explores the crucial role of private sector participation in defence R&D in India, comparing it with global benchmarks. While India is the fourth-largest defence spender globally, the investment in R&D remains low at 0.64 per cent of its gross domestic product, significantly below global leaders like the US and South Korea. Private sector contribution to defence R&D in India is limited, with an R&D intensity of 1.2 per cent, compared to the global average of 3.4 per cent. The chapter examines the public sector's dominance, particularly through the Defence Research and Development Organisation and the defence public sector undertakings, alongside the growing involvement of private firms through initiatives like Make in India, Innovations for Defence Excellence (iDEX) and the Technology Development Fund (TDF). The 25 per cent reservation of defence R&D budget for private industry has opened opportunities for start-ups and micro, small and medium enterprises. However, it still needs to be operationalised. The chapter also highlights challenges, such as bureaucratic delays, low intellectual property generation and limited collaboration between academia and industry. Bhattacharyya recommends enhancing tax incentives, improving industry–academia collaboration, fostering a skilled workforce and streamlining procurement processes to accelerate innovation and self-reliance in defence. With sustained effort, India can build a robust defence R&D ecosystem, reducing its reliance on imports and strengthening its national security.

A nation's military prowess is based largely on its capability to develop and exploit systems and products, both defensive and offensive. There are two main ways to acquire these, that is, either buy outright from friendly nations or develop these products in-house within the country. Today, it is widely accepted that the first recourse to acquiring military equipment should ideally be through indigenous development. Nabanita Radhakrishnan's chapter, 'Advancing Domestic R&D Capacity in Defence: Role of Academia', explores the evolution of a military product and the players involved in development at various Technology Readiness Levels (TRLs), focusing in greater depth on those at the bottom of the TRL chart, that is, the creators of basic research, who lay the foundation for R&D. Ideally, this role is reserved for academic institutions. The chapter also takes a comparative outlook at defence–academia linkages in a few select countries, namely, the US, the United Kingdom (UK), Israel and China. It notes that academic centres of higher learning in science and engineering have always been contributors to a nation's defence capability in various forms, starting from basic research right up to development of weapons systems in certain countries. The chapter concludes with recommendations to enrich the ecosystem in India through defined roles and processes.

The Government of India is committed to building a robust domestic defence industry. For this, it has taken certaint initiatives, namely, reforms in Defence Procurement Procedure, TDF, iDEX/Prime, Swavalamban, Acing Development of Innovative Technologies with iDEX (ADITI) scheme, which have been path-breaking in concept and approach. However, there are gaps in implementation. It is important to take stock of how these and other reforms have performed. Jayant Patil, in 'Navigating Protracted Wars and Sanctions: Mitigating Risks in Defence Production', raises the issue of why, despite promulgating reforms policies and government's positive intent, India continues to be among the largest importers of defence hardware. He goes on to flag issues that are important and need the government's attention to build military industrial ecosystem: dependable supply chains with ability to scale up at short notice; using innovative thinking; and modularity in design, engineering and production. Adaptation of Civil–Military Fusion model followed in developed nations and recommended by multiple expert committees in past has also been flagged by the author. Towards building self-reliance and sustenance for protracted war situations, Patil emphasises the need to review current models, draw lessons, institute innovative models and encourage industry for building capabilities by leveraging dual-use technologies.

The capacity of a state to wage war for a prolonged period depends upon the

economic and military might at its disposal. The two ongoing wars, between Russia–Ukraine and Israel–Hamas, have dispelled the notion that in an increasingly globalised and interdependent world, only 'short, intense wars' are likely. Considering India's geopolitical environment, a realistic assessment of its capability to undertake conventional military operations, below the nuclear threshold, over a protracted period, thus merits closer examination. Abhay Dayal's chapter, 'Navigating Protracted Wars and Sanctions: Mitigating Risks in Defence Resource Management', analyses both direct as well as indirect impact of India being involved in a prolonged conflict under the shadow of sanctions. It attempts to identify the supply chain issues being faced by India regarding fully integrated defence systems as well as sub-components and spares, considering the two ongoing wars. Lessons about the need for indigenising defence R&D as well as production have also been drawn with an effort to arrive at practical and implementable steps required to be taken for the same. With India still topping the list of arms importers in the world, a two-pronged approach of mitigation measures, to be implemented at international level as well as domestically, has been recommended.

The Indian defence industry has witnessed a steady stream of policy reforms to help 'level the playing field' for private defence manufacturers in the country. These reforms have helped increase the contribution of private industry to the country's overall defence production. In fact, in 2023–24, the share of private industry in defence exports from India stood at 60 per cent, while that of the public sector was 40 per cent. This demonstrates that private defence manufacturers can add significant value and spearhead defence exports from India. Despite such domestic improvements, the global security and economic environment has been rife with conflict and protectionism. This has led to increased military spends across the world, and the global defence industry has shifted into high gear as a result. However, defence production, both global and domestic, is susceptible to externalities, like wars, low-intensity conflicts and, more frequently used, sanctions regimes. These externalities can disrupt supply chains, hinder defence exports and impede innovation as well as R&D in defence. Rajinder Singh Bhatia's chapter, 'Defence Production and R&D in India: Adapting to Externalities', focuses on identifying the impact that protracted wars and sanctions regimes have on defence production, and the role that the Indian defence industrial sector has to play in this changing landscape of modern warfare.

Geopolitics of the emerging multipolar world has exacerbated India's strategic vulnerability. Russia's protracted involvement with Ukraine and the spectre of sanctions by the US and some of its North Atlantic Treaty Organization (NATO)

allies for continued dealings with Russia threaten India's traditional and emerging sources of supply of military hardware and technology. The strategic autonomy India aspires for requires self-reliance in developing critical technologies that constitute the core of military capabilities its armed forces need. India has done well in some areas, like missile technology, while some others, like jet engine technology, continue to cause concern. This is where the Make in India initiative was expected to fit in, but it is focused more on local production of equipment and less on developing critical and futuristic technologies. Amit Cowshish, in his chapter, 'Collaboration with Foreign Partners for Self-reliance', recommends that this policy needs to be revisited to see if structural, procedural, budgetary and attitudinal reforms are required to mitigate the risks of critical dependence on foreign sources of supply. This is not to suggest preclusion of foreign collaboration, but the efficacy of the current practice of seeking transfer of technology while buying military equipment as the primary means of achieving self-reliance and the advantage of running disjointed schemes for technology development need to be reassessed.

Facing a worsening security environment, Japan adopted three new security documents in December 2022, which transformed its defence posture from exclusively defence oriented to an offensive one, possessing counter-strike capability. The documents also emphasised strengthening of the Japanese defence industry as an inseparable defence capability, while exploring a way to revise arms export policy. Galvanised by the logistics demand in Russo-Ukraine war, the Japanese Ministry of Defense decided to invest 18 trillion Japanese yen for enhancing sustainment and resilience for the next five-year plan, supported by increased defence budget. In parallel with these domestic defence initiatives, Japan moved forward to reinforce Japan–US alliance by declaring unity of response to Russia's aggression through financial sanctions, export controls and other steps. It also established a new framework, Defense Industrial Cooperation, Acquisition, and Sustainment or DICAS, to expedite bilateral logistic cooperation. While Japan and the US officially agreed to mutually complement supply chain to meet surging demand in wartime, how private sectors who might have conflict of interests would respond to this objective remains to be seen. With these recent developments, Sadamasa Oue, in 'Logistics in the Times of Protracted Conventional Wars Under the Shadow of Sanctions and Export Control Regimes: Japan's Perspective', argues how to realise resilient logistic supply chain to support possible war in the future. He proposes the following: revise Japan's arms export policy to adapt to the reality; expand logistic cooperation among Quadrilateral Security

Dialogue (QUAD); and encourage Japanese defence industry to collaborate with foreign partners.

This book, a compendium of papers presented during the inaugural edition of DDD, advances India's strategic discourse on modern wars driven by technological advancements, shifting geopolitical landscapes and emerging threats. As India aspires towards greater self-reliance and leadership in defence, these chapters offer a foundation for developing nuanced and adaptive strategies to navigate the complexities of modern warfare. The chapters provide a comprehensive overview of critical issues facing India's defence landscape. The contributions span a wide spectrum—from evolving operational doctrines to strategic partnerships and from defence R&D to the imperatives of supply chain resilience. Each chapter captures a unique perspective, offering valuable insights that collectively strengthen the overarching vision of India's defence preparedness and its role in regional and global security dynamics. The compendium is more than a collection of academic and strategic insights; it is a call to action for policymakers, defence experts and scholars to collaboratively shape India's future security framework. As the country navigates the uncertainties of the global security environment, the dialogue and reflections captured within these pages serve as a guiding compass. It is the hope that the deliberations from the DDD 2024 will continue to inspire informed decision making and help secure India's future.

PART I

Full Spectrum Threats: Challenges of Changing Character of Warfare

2

Conventional Wars Reassessed: Great Power Competition and New Age Technologies

Rajneesh Singh

Since the end of World War II in 1945, there has never been a Great Power war, even though the world has witnessed several limited wars and conflicts. This has largely been attributed to the dominant military capability of the USA, the availability of weapons of mass destruction with adversarial countries, and the rule based international order enforced by the Western alliance. The emergence of China and other regional powers, in the last few decades, is posing a challenge to the established order, especially the hegemony of the USA and the Western alliance. Despite the rise of China and other regional powers, the USA and the West are not in inevitable decline, and continue to remain global economic and military power houses. If history is to be believed, the ongoing great power competition will manifest itself in irregular competition[1] as well as wars and conflicts in various forms on the boundaries and limits of great powers.[2]

Russia's actions in Ukraine—initially in 2014 and subsequent invasion[3] in 2022—China's Gray Zone warfare in the Himalayas and the South China Sea, the ongoing Gaza War, and the rise and (apparent) fall of the Islamic State and Al Qaeda have all reignited the debate regarding the changing character of warfare.

In his book, *On War,* Carl von Clausewitz, Prussian General and military theorist, has differentiated between the enduring nature and the changing character of war, unique to each period. Factors which contribute to war's immutability

include its inherent violence, its human dimension, and its guiding politics while, on the other hand, technology, society, culture, geopolitics, economics, trade, and history determine how war is fought. All these make for the character of war during a particular period.[4] The changes in the character of warfare, driven by the social and political context of the time as well as technology, among many other factors, have been enduring features of wars and conflicts. In more recent times, the flux in warfare has largely been driven by the pace of technological advancement in material sciences, electronics, and communication. The changes in warfare are of great interest to military theorists and practitioners alike, as they help prepare and plan for future wars—from doctrine to procurement and force restructuring to training are determined by the changing character of warfare.

Flux in the International Order and the Surging Risks of Wars

Following the end of the Cold War, the world witnessed a brief period of unipolarity, with the USA being the sole superpower. The hegemony of the Western alliance, led by the USA, is now being challenged by the rise of China, and the growing cooperation among China, Russia, Iran, and North Korea. China's growing power and revisionist tendencies are being fuelled by its rapid and sustained economic growth, military and nuclear modernisation, and technological advancements. As a result, the escalatory tendencies are being felt worldwide, resulting in geopolitical hotspots on every continent. For a long time, the USA worked to prevent the emergence of peer competition. In 1991, the George H. W. Bush administration prepared a defence guidance document to stymie the emergence of any competition, and the various National Security Strategy documents that have followed have all highlighted the need to maintain US pre-eminence,[5] even though there is an acceptance of the return of multipolarity and great power competition.

The debate between the relative stability of a multipolar versus a bipolar world order is an old one, with opinions divided regarding which is a more stable order and one that is less prone to wars and conflicts.[6] There are some who suggest that the flexibility of a multipolar world order may create uncertainty, enabling revisionist power to alter the status quo.[7] The disruptive aspects of great power competition and multipolarity are coming into fore in contemporary times. The diffused power centres and dispersed sources of threats are stress-testing existing deterrence mechanisms, and have the potential to cause significant disruptions.

The great power competition, two major wars (in Ukraine and in Gaza), the

tensions in the Himalayas, and the East and South China Sea are defining the geopolitical landscape of the third decade of the 21st century. In addition, tensions between Azerbaijan and Armenia, Serbia and Kosovo, and military takeover in Myanmar, and in countries in Africa, are all symptomatic of the times to come. The great power competition and geopolitical hotspots have the potential to engulf wider geographies, create fissures, and destabilise an already fragile global situation.

Global military expenditure has registered a 6.8 percent increase in 2023, which is the steepest year-on-year increase since 2009, to reach a record US$ 2,443 billion. The Stockholm International Peace Research Institute (SIPRI) report of April 2024 has attributed the rise to the ongoing war in Ukraine, and the escalating geopolitical tensions in Asia and Oceania, and the Middle East.[8] The military spending by countries, which witnessed an increase in all five geographical regions for the first time since 2009, further substantiates the rise of geopolitical tensions and the increasing danger of wars and conflicts.

Competitions and Wars in the Time of Great Power Competition

During the Cold War, the two superpowers, the USA and the Soviet Union, and China were nuclear powers which prevented direct military confrontation between them. Today, the situation has changed, and the USA and China possess extremely advanced militaries, backed by political, diplomatic and economic heft, and Russia is working to re-establish its influence. Defence analysts can learn lessons from the past and, perhaps, draw some parallels for the future. While history does not repeat itself, as Mark Twain reminds us, it often rhymes.[9] Thus, even though the future cannot be predicted with any amount of certainty, yet historical evidence become important while planning the future.

In their *War on the Rocks* commentary, Jacob Shapiro and Liam Collins, citing the Upsala Study Data Program,[10] have concluded that 107 of the 123 armed conflicts active around the world from 1975 to 1991 were civil wars, and other kinds of irregular war. Furthermore, 26 violent conflicts during the period, wherein two or more great powers supported the combatants, accounted for 64 to 75 percent of the battlefield fatalities; and, all these wars lasted for more than a decade.[11] The Cold War was also the period where the two superpowers, the USA and the Soviet Union, got directly involved in disastrous wars in Vietnam and Afghanistan. During this period, there were cases of even non-nuclear powers getting involved in conventional wars with the support of one or both the superpowers. Prominent among them were the 1965 and 1971 India-Pakistan

Wars, and the Six Day War and the Yom Kippur War between Israel and its Arab neighbours.

If the Cold War case studies are a guide to the future, we may expect great power rivalry to increase in intensity and scope. We can expect the rivalry to manifest itself in the forms of 'friendly' and 'adversarial' irregular competitions,[12] 'gray zone' activities,[13] and limited conventional wars. Friendly competition is between friends, partners and allies, while those undertaken by adversarial countries and non-state actors, which do not elicit a violent reaction, would classify as adversarial competition. Some of the examples of adversarial competition include activities such as, but not limited to, economic coercion, theft of intellectual property, military intimidation, influencing elections, cyber enabled disinformation campaigns, the sale and transfer of weapons, etc.

Gray zone activities have been variously classified. One such classification involves categories such as aggressive, moderate, and persistent.[14] This classification is based on the type of military action, attributability to the source, objectives, and the legality of the action. Gray zone activities pursue political objectives, but do not merit major military response from the adversary.

The third category is limited conventional war against a nuclear backdrop, which is the subject of deliberation of this paper.

Changing Character of Warfare and the Need to Assess the Future

Since the beginning of the 21st century, the world has witnessed two major shifts in the way wars are being fought. In the early years of the century, the USA was the sole superpower. China was still in the process of enhancing its economic might and reforming its military, and Russia was grappling with the aftermath of the breakup of the Soviet Union. It was under these circumstances that Al Qaeda launched the '9/11 attack' on the USA. At that time, it was asserted that warfare had changed, and militaries henceforth would be involved in counter-terrorist and counter-insurgency operations, and that conventional wars were a thing of the past.[15]

By the middle of next decade, there was a gradual shift in warfare, and Russia and China began employing gray zone tactics. In 2014, Russia occupied the Crimea peninsula, and China's seizure and fortification of atolls in the South China Sea were representative of state based coercive activities. There have also been several instances of Chinese aggressiveness in the Himalayas along the Line of Actual Control (LAC), leading to military confrontation between the People's Liberation

Army (PLA) and the Indian Army (IA). Prominent among these are the Doklam Standoff of 2017, and the Eastern Ladakh Standoff of 2020.

The reemergence of great power competition has changed the geopolitical landscape of the world, with a greater possibility of military confrontation between near peer adversaries. There is now a shift in focus from expeditionary warfare for counterterrorist operations to conventional warfare against a peer competitor. The Chinese and Russian gray zone actions, and the two ongoing wars in Ukraine and in Gaza, have reignited interest in large scale protracted conventional wars, fought against the backdrop of supply chain disruptions due to sanctions and export control regimes.

The militaries around the world commit substantial time and resources to assess the future of warfare. It is a continuous exercise, undertaken to avoid being surprised by the adversary, or being outdone due to some technological advantage. The assessment of the future of warfare is important since it impacts future policies, force development, and acquisition choices, besides preparation and the conduct of war. At the same time, it is important that the assessments are appropriately tempered to prevent factoring in of some exaggerated future threat, or some promising technology which does not live up to its expectation.

Large Scale Protracted Conventional Operations

In the last two decades the character of warfare has been profoundly impacted by the resurgence of great power competition and the shifting of strategic priorities. There has been a significant transition from counterterrorism focussed operations to large scale protracted conventional operations against near-peer adversaries. The ongoing wars in Ukraine and Gaza are cases in point. The conduct of military operations has been further complicated by the impact of the advancements in technologies, the dynamics of supply chain management, and sanctions and export control regimes that some of the advanced countries can enforce. In response to the mentioned dynamic conditions, the following factors will have a direct bearing on military strategies and tactics, force structures, kitting and procurement policies and the training of the armed forces to undertake large scale conventional operations.

- *Multi-domain Operations.*[16] In the early 2000s, there was a heightened interest in a form of warfare which combined conventional and unconventional forms of warfighting. This form of warfare came to the fore because of advancements in technologies, and the employment of

State and non-State actors, unrestricted by the laws of armed conflicts. Several new terms—hybrid warfare, gray zone warfare, and multi-domain warfare—entered the lexicon of military discourse.[17] There are military historians who contend there is nothing new in these terminologies, and there were many unconventional activities in the classical conventional wars of the past. The reason for renewed interest was the publication of an article by General Valery Gerasimov, Russia's Chief of the General Staff, in the *Military Affairs Courier*, 'The Value of Science is in the Foresight.'[18] The advancements in technology have led to its democratisation, allowing State and non-State actors to acquire capabilities, available only to advanced countries earlier. As a result, the armed forces of any country are expected to confront adversaries in every domain—land, sea, air, space, and cyberspace, and across physical, human, and the information dimension. The armed forces, along with other security agencies, are expected to compete in all domains to deter adversaries, failing which undertake conventional operations.

- *Massed Fires and Precision Strikes.* The employment of massed fires and precision strikes in a digitised battlefield, with the proliferation of sensors, will make the future battlefield extremely lethal. The digitisation of battlefield systems would require developing and fielding a state-of-the-art command and control system (C2), and the integration of intelligence, surveillance, and reconnaissance (ISR) data. In addition, to maximise the effect of massed fires and precision weapon systems, there will be a requirement of prioritising data, and the judicious allocation of resources, besides developing flexible doctrines, effective resource management, and robust training and coordination. Balancing massed fires and precision strikes in future large-scale conventional operations will maximise operational effectiveness while minimising collateral damage.
- *Unmanned Systems.* The unmanned systems are, possibly, among the most discussed disruptive technology in the ongoing Ukraine and Gaza War. It is assessed that these systems have a transformative potential, when employed in a network centric environment, in combination with digitised C2 systems and state of the art sensors.[19] The unmanned systems vary widely in capability, cost, and method of operation—remote-controlled, semi-autonomous, and autonomous modes. In all future battlefields, unmanned systems will be used extensively to enhance operational efficiency by providing real time ISR, improved situational awareness, assistance in

streamlining mission planning, and enabling precision strikes. The armed forces will also require to suitably adapt to the evolving nature of warfare driven by this technology by incorporating structural changes as well as changes in training and doctrines.

- *Logistics for Protracted Wars.* In the ongoing war in Ukraine, Russia has been able to persist because of its industrial resilience, and the ability to withstand economic sanctions imposed by the West. The West imposed a ban on the export, re-export and transfer of any commodity, software, or technology that is essential for Russia's defence, aerospace and maritime sectors. It is under these circumstances Russia has been fighting the war, which is in its third year. The country has managed to mitigate the impact of the oil embargo by tapping the markets of Asia, with the bulk of the energy supplies being exported to China and India. Moscow has also benefited from effective fiscal management which shielded the financial sector from the impact of sanctions, and prevented financial crisis. To replenish its defence equipment, Russia has imported drones, ammunition, and other requirements from Iran and North Korea. Not only on the homeland but also on the battlefields the adversary will attempt to disrupt the supply route from rear areas to frontlines. It is the primary responsibility of the government and the military leadership to equip the armed forces with required wherewithal to ensure that the military achieves its stated objectives. In all future wars, protecting the sources of supplies and supply lines will be vital to sustaining operations.

Technology and the Changing Character of War

The Strategy, Statecraft, and Technology (Changing Character of War) Centre (SST-CCW) at the Oxford University is studying the character and nature of armed conflict since 2003.[20] The study has identified six themes of change—that is the character of warfare—which merit attention: context, techniques, domains, technologies, constraints, and ideas and military thought. When these six elements of change are examined in relation with six elements of an unchanging nature as well as six elements of continuity offer, comparisons, measure effect, calibrating the degree of change, and evaluating responses become apparent.[21] Of the six themes of changes identified by SST-CCW, in the context of two ongoing wars in Ukraine and Gaza, technology, perhaps, has had the greatest impact on the changing character of warfare.

The First Gulf War (1990–91) revealed the power of technology, and brought

in a paradigm shift in the way war was viewed. It was a revolution in military affairs (RMA).[22] Incidentally, Clausewitz had missed the importance of technology as a variable in his analysis of war.[23] The oversight was, perhaps, because the history of war is characterized by long phases of technological inertia, interspersed by occasional spasms of revolutionary change.[24] In the last over fifty years, the pace of technological advancement has been overwhelming. For comparison, the 'spindle', one of the hallmarks of the first Industrial Revolution, took over a century to spread outside Europe. In contrast, the internet established its presence around the world in less than ten years.[25]

In the ongoing wars, artificial intelligence (AI), sensors, highly precise long distance attack capabilities, and integrated weapons platforms are defining the outcomes of battles. Robotics and additive manufacturing are being experimented as weapon platforms, and for logistic functions. Space-based assets, and lethal autonomous systems are all increasingly becoming operational realities of war. The potential of technology, such as quantum computing, is being deliberated. These technological advancements will become operational imperatives in the foreseeable future.

The Operational Impact of Technology

The advancements in military and dual use technology have transformed the way wars are fought. In addition, there are technologies, and their military applications, that are still in a developmental stage, such as quantum computing and the AI, which have the potential to change wars, in ways unimaginable today. Military leadership must adapt to this changing landscape by integrating new technologies for operations, and develop military capabilities to counter emerging threats. The adoption of new technologies requires militaries to develop new operational concepts, and reorganise and restructure forces in sync with the new weapon platforms and systems, thereby maximising the potential of the technologies. It is quite likely that the new technologies are evolutionary, rather than revolutionary, necessitating a vision for employment and incremental steps in their adoption.[26] The future military technologies present both challenges and opportunities to the military leadership, and are vital for favourable outcomes in battlefields.

Military Command and Control and Force Structures

The advancements in technology have the potential to converge. Non-physical domains such as space, cyber, information environment, and traditional warfighting domains (land, air and maritime) are now leading to multi-dimensional

battlespaces—physical, cognitive and virtual. Concurrently, it is important to factor in the possibility of non-linearity and simultaneity of operations.[27] To maintain a decisive advantage over the adversary in the battlefields of the future, it is imperative to develop a cohesive strategy in all operational domains to be effective in multi-dimensional battle spaces. It is also important that military hierarchy remains mindful of the advancements in technology, which will have a direct bearing on the command-and-control setup, and organisational structure of the armed forces.

Speeding up the Operational Tempo and Compression of Decision-Making Cycle

AI is poised to significantly enhance the operational tempo and compress decision-making cycles in future wars in several ways. With the advancements in technologies, new systems are being developed that will generate enormous amount of data which will help military leaders identify the enemy's vulnerabilities and targets. AI will be used to rapidly process vast amounts of data from various sources, enabling the military to quickly identify threats, patterns, and opportunities, allowing for faster and more informed decision-making. By leveraging historical data and real time inputs, AI has the potential to predict the adversary's behaviour and actions, enabling commanders to respond proactively rather than reacting to situations. AI also has the potential to recommend actions based on complex modelling and simulations. More importantly, AI based systems are likely to have capability to adapt in real time, allowing for real time adjustments as per the unfolding battlefield situation. These capabilities will lead to speeding up the operational tempo, and compressing decision making cycle in future wars.

The Impact on Logistics

Traditionally, technology took years and, in some cases, decades to develop and mature. In the Ukraine war, some of the technologies, such as the unmanned systems which are relatively inexpensive and quick to develop and modify, are not only challenging the dominance of established industries but also the procurement procedures of the relevant government departments. Traditional procurement procedures are beset with red tape and bureaucratic delays, leading to cost overruns. New technologies are necessitating changes in governments procurement procedures, wherein governments and the militaries may consider the deploying of the technologies even before they are fully developed, and they may be modified

to suit the requirements of the armed forces later. This would require changes in government procedures and processes.

Conclusion

As we look towards the future being increasingly defined by complexity and uncertainty, and the attempt to assess the changing character of warfare, comprehending and adapting to changes will be essential for maintaining strategic advantage, and ensuring national security. It is likely that the future of warfare will be defined by large-scale, protracted conventional operations against near-peer adversaries, yet fundamentally different from how wars were conducted in the beginning of this century. Technological advancements will play a critical role, influencing military strategies and tactics as also force structures and training programs, while dynamics in supply chain management, along with sanctions and export control regimes, will directly impact procurement policies.

To effectively navigate this shifting landscape, military organisations must be flexible to adapt and innovate. This involves not only the integration of emerging and disruptive technologies but also the development of flexible strategies that can respond to the multifaceted nature of modern warfare.

NOTES

1 Irregular competition is defined in this work as 'state and non-state actors proactively engaging in activities to influence populations and affect legitimacy during times of peace, competition, and war.' 'Irregular Competition: Contemporary Lessons Learned and Implications for the Future of Irregular Warfare' at https://irregularwarfarecenter.org/wp-content/uploads/Future-Faces-of-Irregular-Warfare.pdf, pp. 33, (Accessed August 7, 2020).

2 Rob Johnson, 'The Changing Character of War,' *The RUSI Journal*, 162:1, 2017, pp. 6-12, pp. 10.

3 Russia has termed it as a 'Special Military Operation'.

4 Michael Howard and Peter Paret, *On War*, Princeton University Press, Princeton, NJ, 1976, pp. 88–89.

5 Stephen M. Walt, 'America Is Too Scared of the Multipolar World', *Foreign Policy*, March 7, 2023, at https://foreignpolicy.com/2023/03/07/america-is-too-scared-of-the-multipolar-world/ (Accessed March 20, 2023).

6 Dylan Motin, 'Polarity and War: The Weak Case for the Bipolar Stability Theory', *Journal of International and Area Studies*, Volume 27, Number 1, 2020, 101–120, pp. 101–104.

7 Stephen M. Walt, No. 5.

8 Dr Nan Tian, Dr Diego Lopes da Silva, Xiao Liang, and Lorenzo Scarazzato, 'Trends in World Military Expenditure, 2023', SIPRI, April 2024, at https://www.sipri.org/publications/2024/sipri-fact-sheets/trends-world-military-expenditure-2023, (Accessed August 8, 2024).

9 Curt Taylor, 'Preparing To Win The First Fight Of The Next War', Modern War Institute, February 23, 2024, at https://mwi.westpoint.edu/preparing-to-win-the-first-fight-of-the-next-

war/, (Accessed February 26, 2024).

10 'Uppsala Conflict Data Program', at https://ucdp.uu.se/, (Accessed August 8, 2024).

11 Jacob Shapiro and Liam Collins, 'Great Power Competition Will Drive Irregular Conflicts', War on the Rocks, April 8, 2024, at https://warontherocks.com/2024/04/great-power-competition-will-drive-irregular-conflicts/, (Accessed April 10, 2024).

12 J. 'Lumpy' Lumbaca, 'Irregular Competition: Contemporary Lessons Learned and Implications for the Future of Irregular Warfare', in Varsha Koduvayur, James Kiras, Richard Newton,(eds.), The Future Faces of Irregular Warfare: Great Power Competition in the 21st Century, at https://irregularwarfarecenter.org/wp-content/uploads/Future-Faces-of-Irregular-Warfare.pdf, (Accessed August 7, 2024), pp. 35.

13 In this essay, terms such as 'gray zone', 'hybrid', 'irregular', and 'multidomain' have been used interchangeable to define the activities which are short of war but have elements of adversarial competition, and threat of use of violence involving regular militaries and/or non-state actors.

14 Michael J. Mazarr, Joe Cheravitch, Jeffrey W. Hornung, and Stephanie Pezard, 'What Deters and Why', RAND, Santa Monica, California, 2021, p. 3.

15 'What is war today?', at https://www.ccw.ox.ac.uk/what-is-war-today, (Accessed June 21, 2024).

16 Multi-Domain Operations are the combined arms employment of joint and Army capabilities to create and exploit relative advantages that achieve objectives, defeat enemy forces, and consolidate gains on behalf of joint force commanders. Employing Army and joint capabilities makes use of all available combat power from each domain to accomplish missions at least cost. Multi-Domain Operations are the Army's contribution to joint campaigns, spanning the competition continuum. Below the threshold of armed conflict, multi-domain operations are how Armed forces accrue advantages, and demonstrate readiness for conflict, deterring adversaries while assuring allies and partners. During conflict, they are how Armed forces close with and destroy the enemy, defeat enemy formations, seize critical terrain, and control populations and resources to deliver sustainable political outcomes. See 'Congressional Research Service, Defense Primer: Army Multi-Domain Operations MDO', at https://sgp.fas.org/crs/natsec/IF11409.pdf, (Accessed September 9, 2024).

17 Terms such as irregular, 'hybrid', 'gray-zone', 'fourth-generation', 'new-generation', 'asymmetric', 'compound', 'political', and 'unrestricted' 'warfare' are often used interchangeably to describe this complex operating space. See J. 'Lumpy' Lumbaca, No 12, pp. 34

18 General Gerasimov wrote: 'The very 'rules of war' have changed. The role of non-military means of achieving political and strategic goals has grown and, in many cases, they have exceeded the power of force of weapons in their effectiveness. … All this is supplemented by military means of a concealed character.' See Rob Johnson, 'The Gerasimov Doctrine', *Politico Magazine*, September/October 2017 at https://www.politico.com/magazine/story/2017/09/05/gerasimov-doctrine-russia-foreign-policy-215538/, (Accessed January 5, 2023).

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24 Warren Chin Technology, 'War and the State: Past, Present and Future', *International Affairs*, 95: 4, 765–783, 2019, pp. 767.

25 Klaus Schwab, *The Fourth Industrial Revolution*, Penguin Random House, London, 2017, p. 8.

26 'Rethinking Fire and Manoeuvre across the physical and non-physical aspects of domains', at https://hcss.nl/wp-content/uploads/2023/11/HCSS-NATO-ACT-Symposium-Report-Rethinking-Fire-and-Manoeuvre-2023.pdf, (Accessed June 21, 2024).

27 'NATO's Warfighting Capstone Concept: anticipating the changing character of war', at https://www.nato.int/docu/review/articles/2021/07/09/natos-warfighting-capstone-concept-anticipating-the-changing-character-of-war/index.html, (Accessed July 16, 2024).

3

From Territory to External Operations to Statecraft to Adaptability: Main Trends in Jihadist Militancy

Riccardo Valle

Introduction

In the last ten years, the militant landscape across the world has changed dramatically in several aspects. Global jihadist organisations are adopting new types of policies and tactics to adjust their global vision and strategy. On the other hand, local jihadist organisations are exposed to regional trends that have forced them to adapt to changing political, social, and security environments, posing new challenges to security forces and State authorities.

Dramatically, the militant scenario has become more difficult to dissect due to competition between different factions of jihadist groups. The Islamic State, Al-Qaida, and their affiliates, and other independent jihadist organisations compete for resources, recruits, and territorial strongholds on several fronts, from Africa to Afghanistan and Central Asia and Europe. The competition takes the form of open conflict in different areas, such as in West Africa and the Sahel region, where jihadist groups battle security forces, local militias, mercenary units, and other jihadist organisations, enabled by the low level of control on large pockets of territory.

Furthermore, militants are progressively taking advantage of international crises and developments to advance their own goals. The exacerbation of the

Israel-Palestine conflict in Gaza has provided militant organisations across the jihadist spectrum with fuel to invigorate their prominence in the religio-political discourse, sparking a new wave of so-called lone wolf attacks in the West. Similarly, the Islamic State has taken advantage of the conflict in Ukraine, and the distraction of security forces to make its move and carry out devastating attacks in Russia while coordinating a number of other plots in the country.

Some jihadist militant organisations effectively reached their goal and established Islamic states, enacting their form of government, as in the case of Hayat Tahrir al-Sham in the Idlib region, Syria, and the Afghan Taliban in Afghanistan, injecting new life into those militant organisations that follow the same goal, such as the Pakistani Taliban. The Afghan Taliban have, *de facto*, become a source of imitation for regional jihadist organisations that want to obtain territorial gains while also keeping their struggle localized, hoping to achieve recognition by the international community.

On the other hand, in Afghanistan, the conflict between militant groups has taken the shape of a series of counter-terrorism operations led by a former insurgent force against another jihadist group, providing a unique and new dynamic with a dramatic impact on regional stability, and setting a precedent on how a local branch of a global jihadist organisation can effectively harbour international ambitions.

Battle for Territory and Jihadist Proto-States in Africa

Within the last three years, several militant organisations have focused their attention on shifting from only pure brutal attacks and the occupation of territories to a more calculated approach that combines a mix of warfare, deadly operations, and localized strategies to win the support of communities in order to maintain prolonged footholds in regions. This shift often responds to mutating environments, pointing to the fact that militant organisations are capable of quickly adapting themselves to changing scenarios, even the most hostile to them, while framing new tactics in order to take advantage of the weaknesses of regional states and the international community. The most vivid example of such transitions is in Africa, especially in war-torn areas, such as West Africa, the Sahel region, Central Africa, and East Africa. Here, the two major jihadist fronts, represented by the Islamic State and Al-Qaida, and their respective local branches/provinces, alternate fighting with security forces for the control of territories with intra-jihadist struggle.

The trajectory of post-Abubakar Shekau's Jamaat Ahle Sunnat lid-Dawati wal Jihad (JASDJ, or Boko Haram) is descriptive of such a transition and adaptive

capabilities in a post-leadership decapitation condition, and a highly hostile environment in 2021.[1] Surrounded by enemies—Nigerian security forces and African coalition's forces (Multinational Joint Task Force, MNJTF)—and in competition with Islamic State West Africa Province (ISWAP), the main faction of JASDJ, the Bakura faction, has been able to recover from a fragmented situation, and become a major force in the Lake Chad area, displacing the previously in charge ISWAP.[2] Between 2022 and 2024, JASDJ's Bakura faction was able to conquer several of Lake Chad's islands which ISWAP previously occupied.[3] The faction managed to lure disgruntled ISWAP commanders into JASDJ to gain the upper hand; however, it was also able to stabilize itself in the area thanks to a series of new policies adopted by the group.[4]

On an international level, the head of the Bakura faction, Bakura Doro, understood that it was necessary to withdraw from any global jihadist aspiration, hence abandoning the legacy of the previous leader, Abubakar Shekau, and halting the production of videos and public messages which could capture international attention.[5] Thus, the Boko Haram phenomenon which, until 2021, was heavily featured in the international media, completely disappeared, enabling the group to recover and grow its strength. On a local level, Bakura Doro has, for now, effectively maintained a balance between a proto-taxation system of the areas and population he controls (following ISWAP model) with the Shekau's raiding system to acquire and allocate resources within the group.[6] While this model might also spark tensions between sub-factions and commanders, for now, it seems this system has enabled the group to survive. Finally, the Bakura faction has dropped the number of attacks against the installations of the security forces in the Lake Chad region, avoiding open confrontation, while concentrating its resources on tackling ISWAP influence, taking advantage of the inaction featured by the four Lake Chad States.[7]

In sum, in less than three years, Boko Haram's main faction was able to recover and expand its territorial influence and kinetic capabilities without conducting a major offensive against security forces but by solely relying on intra-jihadist politics and fighting and in carving out pockets of territorial strongholds by exploiting the indecisiveness of regional states, plagued by political turmoil (Niger) or lack of cooperation among coalition forces.[8] It also highlights how the approach that Lake Chad countries have adopted towards the intra-jihadist conflict—that is, waiting for both JASDJ and ISWAP to weaken each other—is not working, as it is only giving time for jihadists to assess new tactics to face the security apparatus.[9]

The intra-jihadist competition in the Lake Chad region is mirrored in the Sahel region by the bloody conflict between Al-Qaida affiliated Jamaat al-Nusrat al-Islam wal-Muslimeen (JNIM) and the Islamic State Sahel Province (ISSP, formerly the Islamic State Greater Sahara group). Here, the spreading political instability in Mali, Niger, and Burkina Faso has plagued the capabilities of other States, such as Benin, to effectively counter the rapid expansion of JNIM and ISSP from Mali to neighbouring areas.[10] Both groups have been battling each other for years, with JNIM having the upper hand.[11] However, as in the case of the Lake Chad region, the infight has not caused a general dwindling of the groups' power bases. Contrary to the expectations of regional countries that JNIM and ISSP would degrade each other, thus allowing for security forces to subsequently dismantle the remnants of the two groups, recent ISSP offensives have succeeded in dislocating JNIM militants from towns and villages in Mali, forcing JNIM to look to expand its influence within coastal West Africa, ramping up attacks in Côte d'Ivoire, Benin, Togo, and Ghana.[12] At the same time, JNIM has practically set up a parallel administration in those areas it now controls between Mali and Burkina Faso. The group currently occupies 40 per cent of Burkina Faso, enforcing its controls over large swathes of territory and the local population; recently, it was able to strike in the proximity of Kaya, a large bastion outside of the country's capital of Ouagadougou, threatening its fringes.[13]

Thus, both groups have been pushed to intersect new regional dynamics, such as JNIM's intermittent alliance/cooperation with some Tuareg rebels who, from time to time, alternate between being enemies—chiefly, the National Movement for the Liberation of Azawad (MNLA)—and neutral actors towards JNIM. The cooperation has stretched to the extent that, recently, the JNIM and Tuareg factions, such as the High Council for the Unity of Azawad (HCUA), have mildly cooperated against Russian mercenary forces in support of the military junta in Mali, inflicting heavy losses against Russian forces.[14] Moreover, the presence of Russian mercenary forces in the region has galvanized jihadist militants, possibly adding a new element of instability to the region, especially if adding the element of the withdrawal of US presence in Niger, which is a crossroad for ISWAP and ISSP fighters whose call for establishing an Islamic State is already appealing to communities in the south of the country.[15] As a result, militants are selectively targeting humanitarian convoys in the region to disrupt international assistance, so that militants are the only actors to which the local population can rely for basic necessities.[16]

The trend of jihadists taking control of swathes of territory and setting up parallel administrations with the aim of ultimately establishing Islamic states/emirates is largely also shared in other parts of Africa, including the Democratic Republic of Congo (where Islamic State Central Africa Province, ISCAP, is active); Mozambique (where Islamic State-Mozambique, or locally known as al-Shabaab, is active); and Somalia (where al-Qaida's affiliate, al-Shabaab conducts its operations). Militant organisations themselves are increasingly putting an effort in openly displaying such control, publishing not only sets of pictures and videos showcasing their manpower but also indulging in non-militant activities engaging local populations. Since the start of 2024, for instance, the Islamic State – Mozambique has published more than 250 pictures featuring various scenes of its militants engaging in combat and other activities. Of these, a third are descriptive of militants interacting with local inhabitants of villages and small towns, mostly holding sessions of religious sermons; enforcing authority; and, distributing food and supplies on the occasion of Islamic festivities, such as Eid ul-Fitr and Eid ul-Azha.[17]

Significantly, the focus on displaying non-militant activities increased in the second half of 2024, while in the first half, most pictures were devoted to showing the militants' advancements deep into populated territories from nearby forests in the South of the country, around Cabo Delgado. These pictures match the regrouping of the Islamic State in Mozambique, as the latter had been previously pushed back, in late 2023, by regional forces backed by Western governments. However, in 2024, due to the incapacity of the local government to enforce its grip over several areas, militants were able to shift their strategy by adopting new approaches, adapting themselves to the local environment and filling the void left by the state.[18] Similarly, ISCAP has been copying the same model of IS-Mozambique, showcasing the occupation of certain villages in the Kivu region of DRC. The group published around 150 pictures, featuring mostly scenes of attacks against Christian-populated villages, and the executions of security forces. However, ISCAP has also displayed that its militants have been able to *de facto* administrate villages, taking care of families, women, and children, distributing food, and having recreational activities.[19]

Threats from Within: Renewed Call for Global Jihad and International Connections

Jihadist organisations worldwide are masters in capitalizing on local and international events with broad repercussions on the international stage.[20] As

part of their strategy, global jihadist organisations, such as Al-Qaida and the Islamic State, have repeatedly exploited media warfare as a complementary tool for recruitment patterns, and inciting attacks outside of their normal operational theatres, particularly in the West. Specifically, local and international crises present excellent opportunities for militant organisations to boost their message, exploit the chaos, and capitalize on them for different purposes. The war between Russia and Ukraine; the ongoing conflict in Gaza; and the revolts in Bangladesh are just some recent examples of how jihadists are able to intersect several dynamics to make gains. The result of this new trend is a renewed call for waging war on non-Muslim and especially Western countries, leading to a surge of attacks—both small-scale as well as highly complex—in Europe and other countries.

The events that occurred on October 7, 2023, sparked an immediate reaction, both from the Islamic State, from several branches of al-Qaida (AQ) and its affiliates as well as other jihadist and militant groups in the Muslim world. Among these, one of the most active jihadist entities that immediately capitalized on the Toofan al-Aqsa operation, amplifying its message, has been al-Qaida in the Arabian Peninsula (AQAP).

AQAP started to release content that directly showed its support for the Palestinians in the conflict in Gaza while linking to it its historic anti-West approach aimed at inciting attacks perpetrated by Muslims from within Western countries. Hence, AQAP issued three new original videos titled, 'Jerusalem Will Not Be Judaized', featuring its militants from undisclosed locations in Yemen while making threats directed against Israel and those countries which support it, specifically the US and Western countries as well as Arab countries with a soft approach to the conflict.[21] In late October, the organisation published an hour-long, detailed interview with the then AQAP leader, now late Khalid Omar Batarfi, on the Toofan al-Aqsa operation.[22] The interview marked the most significant discussion from an AQ branch on the Palestinian offensive, addressing a number of topics in detail, including perceived Iranian influence as well as the organisation's posture towards the USA and Western support for Israel.

Moreover, AQAP closed the year 2023 by publishing another piece of propaganda specifically tailored for Muslims living in the West. The new video, published at the end of 2023, aimed at setting new rules and directives for the year 2024, urging so-called lone wolf attacks by Muslims in Western countries in reaction to the latter's support for Israel.[23] Hence, the video featured numerous indications on how to make explosive devices, stressing the importance of personal

undertakings during jihad. In July 2024, another video from AQAP again reiterated the message of inciting attacks in the West.[24] The video followed a stabbing attack in Mannheim, Germany, carried out by an Afghan refugee targeting an anti-Islam rally, which was officially praised by AQAP in one of its propaganda releases.[25] Since the start of 2024, AQAP has insisted on the necessity to wage war on Western soil to prevent Western governments from supporting Israel through some of its top ideologues, as is clear in a video featuring the prominent religious AQAP scholar, Ibrahim al-Qosi (Khubayb al-Sudani).[26]

Al-Qaida Centre (AQC), too, rapidly capitalized on the conflict in Gaza by issuing a series of statements that transitioned from simply displaying moral support for the Palestinians to actively inciting so-called lone-wolf attacks in the West, and against Western targets in Muslim countries. In November 2023, AQC issued a statement taking advantage of the Israeli bombing of the Al-Shifa Hospital, calling for attacks in the West, and against Western and Israeli nationals in revenge for the massacre.[27] Sayf al-Adl—the alleged leader of AQ—also published several booklets on the ongoing conflict, providing several guidelines for attacks in the West.[28] Such messages were summarized and widely shared by the so-called Electronic Army of AQ, the Manhattan Wolves, which released several posters celebrating the stabbing attacks in Bordeaux, France, and in Wakeley, Australia.[29]

On the other side of the jihadist spectrum, the Islamic State, while opposing Hamas and Al-Qaida, also capitalized on the events in Gaza by calling for indiscriminate attacks in the West in order to remain relevant in the global jihadist movement, and not miss an opportunity to expand its influence. In October, a youngster from Russia's northern Caucasus region stabbed a teacher in Arras, France, posting a video online identifying himself with the Islamic State cause.[30] Shortly afterwards, an individual of Tunisian origins shot and killed two Swedish soccer fans in Brussels, also claiming to act on behalf of the Islamic State.[31] There is a long list of attempted and actual attacks carried out by the Islamic State's individual supporters and cells in Europe and abroad, targeting Western nationals and Israelis, culminating in the recent attack in Solingen officially claimed by the Islamic State, and carried out in revenge for Palestinians killed in Gaza.[32]

The Islamic State's call for attacks in the West to avenge Palestinians in Gaza has intersected with the campaign of international attacks launched by the Islamic State's Central-South Asian branch, in the Islamic State Khorasan Province (ISKP). Located between Afghanistan and Pakistan, ISKP has been developing international aspirations by inciting attacks abroad on the occasion of international events,

such as international sporting events, parades, and against sensitive targets, such as churches. In early 2023, Austrian security forces foiled a plot by three teenagers of Chechen and Bosnian origins in Vienna who were plotting an attack against the annual LGBTQ+ Pride parade.[33] Similarly, in July 2023, the German Federal authorities and the Dutch judiciary dismantled an ISKP-connected cell composed of nine individuals, mostly Tajik nationals, who were planning an attack at the Ibn Rushd-Goethe Mosque in Berlin.[34] Other seven Tajik nationals were subsequently arrested in December 2023 in Cologne as they were planning to carry out an attack against St. Stephen's Cathedral.[35] In July 2024, the Antwerp Federal Judicial Police carried out 14 searches in nine different towns across Brussels, Wallonia, and Flanders, leading to the arrest of seven people connected with ISKP who were orchestrating a series of attacks during the Olympic Games.[36]

The most lethal aspect of such a chain of plots is that ISKP propaganda campaign against the West has overlapped with Islamic State's 'We Are From Them, They Are From Us' campaign, which aims at inciting attacks carried out by Islamic State's supporters even if they are not openly guided or claimed by the organisation.[37] The overlap between these two campaigns has possibly boosted the popularity of such semi-independent and loosely connected cells.

However, the conflict in Gaza is just one of the recent international events exploited by jihadist organisations to advance their goals. The war in Ukraine has provided Islamic State's cells in Russia—mostly made by Tajiks, Uzbeks, and individuals from the Caucasus—to strike one of the main enemies of the organisation.[38] Hence, the March attack in Moscow claimed by the Islamic State had the double effect of exposing Russia's weaknesses in the security apparatus as well as providing jihadists with new *élan* to orchestrate more attacks on Russian soil.[39] As a consequence, in the span of just three months, Russia witnessed three other major attacks: one shooting attack in Dagestan's region in June, and two prison riots in June and August, all claimed by the Islamic State as part of its 'We Are From Them, They Are From Us' campaign.[40]

More recently, Bangladesh has also become a spotlight for jihadist propaganda, possibly anticipating attempted infiltration by jihadist militants, should the situation in the country deteriorate. Shortly after the revolts, both Al-Qaida in the Indian Subcontinent (AQIS), as well as ISKP, published booklets and articles commenting on the events. This might be a signal that both organisations might try to devote resources to local supporters for carrying out attacks from within the country or, alternately, they might continue to produce propaganda targeting local communities with the goal of inciting lone-wolf attacks.[41]

The Afghan Taliban Model and the Role of Jihadist Proxies

The rise to power of the Afghan Taliban, and the return of the Islamic Emirate of Afghanistan in August 2021, represents a watershed moment not only for Central and South Asian countries but also for all jihadist groups that harbour the goal of creating a utopian Islamic government. However, the main jihadist non-state actor that has been directly impacted in several ways—politically, socially, and militarily—is the vast conglomerate of the Pakistani Taliban, broadly divided between the factions of the Tehreek-e-Taliban Pakistan (TTP) and the Hafiz Gul Bahadur group (HGB).

With the return of the Afghan Taliban to power on August 15, 2021, the TTP has been seemingly emboldened both ideologically and operationally, while also adopting new tactics to spread its influence in Pakistan. Since August 2021, the group progressively started a process of consolidating its structure, reaching its apex in January 2023 with the adoption of an organisational layout reminiscent of the Afghan Taliban's during their insurgency period.[42] In 2024, the chart was further updated to effectively enforce the Afghan Taliban's paradigm of supreme leadership into the TTP structure, but excluding the reference to the TTP head from the organisational document, and hence implicitly recognizing its extra-juridical prominence and above-the-law status—similar to the extra-judicial position that the Afghan Taliban's Supreme Leader enjoys outside of the state's structure.[43]

Throughout 2023 and 2024, the TTP announced a new organisational structure, outlining two military zones, North and South, where 13 administrative and operational units (*wilayah*, or shadow provinces) were established. Amongst these, seven units covered the Khyber Pakhtunkhwa province; one in the Gilgit-Baltistan region; two in the Balochistan province; two in the Punjab province; and one in the city of Karachi, Sindh. Each province is further structured into several departments, with related internal administrative units for specific areas which, in turn present different layers of departments on their own. The overall structure of the TTP is further detailed by the presence of different ministries as well as a separate judiciary body that includes three levels for the trial process.[44]

At the same time, the TTP organisational structure is complemented by guidelines for kinetic attacks in Pakistan. The TTP underwent significant changes in this regard: in 2018, the TTP leader, Noor Wali Mehsud, published the first code of conduct, a brief document that set the basic lines for the TTP to carry out attacks in a disciplined and organised manner in order to avoid public backlash

similar to the one faced in 2014 after the Army Public School massacre.[45] However, between 2023 and 2024, the TTP established two new codes of conduct set by the Ministry of War which practically copied, detailed, and enacted the Afghan Taliban's code for military operations during their insurgency.[46]

The combination of the two aspects—the new structure and the body of guidelines for carrying out attacks—has allowed the TTP to establish a united and cohesive jihadist front when facing Pakistan's security forces. Thanks to the new long-term strategy and a new political leadership expert in intra-jihadist politics, the TTP has been capable of forging ties with other Pakistani Taliban sub-factions, either by merging them into its structure or by establishing transactional alliances. As a consequence, since mid-2020, when Noor Wali Mehsud started to shift back TTP militants into Pakistan from Afghanistan, the TTP has absorbed 60 groups, some of them former Al-Qaida affiliates; sectarian outfits; local warlords; and Afghan Taliban-aligned commanders.[47] The most vivid and recent example of such a successful transformation of the TTP in copying the Afghan Taliban model has been the mysterious assassination of Jamaatul Ahrar (the JuA) leader, Omar Khalid Khorasani in Afghanistan in 2022, and the legacy of distrust from JuA members towards TTP Mehsud leadership.[48] The distrust silently grew during 2023, and then, abruptly, exploded in early 2024, with JuA top cadres publicly accusing the TTP leadership of being behind the killing of Omar Khalid Khorasani, and pushing for the complete annihilation of JuA.[49] In the past, the TTP had repeatedly suffered such crises, which led to the fragmentation of the group and its weakening.[50] This time, however, in less than a month, the TTP political leadership succeeded in managing the crisis and pacifying the JuA.[51] As a result, the TTP was able to overcome one of its historical challenges—fragmentation—in a similar way as the Afghan Taliban have been able to do in 20 years of insurgency through a mix of internal appeasing mechanisms, and the intervention of Afghan Taliban's leadership.

However, the TTP is not the only Pakistani Taliban faction that has undergone considerable changes. Since 2023, the HGB too, has shifted from a tribal militia to a structured organisation, albeit still primitive if compared to the TTP. Following the latter's example, the HGB decided to reform, and adopt a gradual shift from a constellation of loosely linked groups to a more robust alliance. Between February and March 2024, the HGB established three new commissions, including Economic, Cultural, and Military, imitating the Afghan Taliban's early years of insurgency in 2003-2004.[52] In parallel, the HGB has also started injecting new life into specific factions of the conglomerate to carry out complex attacks directed

against Pakistan's security forces. Such attacks usually involve the deployment of full teams of *fedayeen* (*inghimasi*, fighters-till-death), preceded by the suicide attack of a militant driving a Suicide Vehicle Born Improvised Explosive Device (SVBIED).[53] The tactic—previously unused by HGB—has been directly borrowed by the TTP, and previously by the Afghan Taliban, and possibly reinforced by the tactical alliance that today the TTP and the HGB share in the North Waziristan tribal district as well as the Khyber tribal district.

The militant landscape in Pakistan has been further exacerbated by the adoption of a new strategy by militant organisations: the use of jihadist proxies by non-state actors themselves. In fact, exploiting non-state actors as proxies is not a new tactic at all in the region, and beyond. As general examples, Iran has been accused of exploiting not only the constellation of militant movements belonging to the so-called Axis of Resistance but also pulling the strings behind the core of Al-Qaida leadership—Sayf al-Adl, allegedly—with accusations coming both from countries as well as some Al-Qaida members themselves.[54] Similarly, there have been several claims that Turkiye would be using intelligence assets provided by Hayyat Tahrir al-Sham (HTS) to hunt down Islamic State leaders.[55]

In the region, the most recent example is the controversial role of the TTP as a double-edged sword connected to the Afghan Taliban. On the one hand, the Afghan Taliban can leverage the TTP as a tool of strategic depth into Pakistan's western border to put pressure on Islamabad; on the other hand, the TTP is also an obstacle to fostering good ties between Kabul and Islamabad due to the brotherly bond between the Afghan and the Pakistani Taliban.[56] After all, Noor Wali Mehsud himself, in a video released in December 2021, stated that the TTP was an extension of the Afghan Taliban into Pakistan's territory, even if the TTP's current strategy is to depict itself as an insurgent, completely native, and independent group to appeal to local and international communities.[57]

However, since 2023, a new trend has surfaced in Pakistan. Following a severe diplomatic backlash between Afghanistan and Pakistan due to a TTP attack targeting police headquarters in the city of Karachi, Sindh, the TTP decided to set up new jihadist entities tasked with carrying out high-level operations. Hence, Tehreek-e-Jihad Pakistan (TJP) and Ansarul Jihad (AuJ) have emerged as new and apparently independent organisations, orchestrating some major operations, often involving suicide attacks, and the storming of heavily guarded security installations. For months, the TJP repeatedly stated it was an independent organisation, claiming no ties with the TTP.[58] However, as accusations from

Pakistan to Afghanistan about sponsoring TTP activities on Pakistani soil increased, the TJP stopped being active at all. And, in 2024, the TTP implicitly admitted that TJP militants were actually part of the group.[59] This is a considerable development, with a non-state jihadist actor setting up a jihadist proxy to advance its agenda against a state.

While the experiment was a half-success for the TTP, it set a precedent for other jihadist organisations, regionally and globally, to copy from, and adapt to, their own conflict against other countries. It signals an advancement in the complexity of irregular and asymmetric warfare by militant organisations that have reached the necessary political maturity to switch from a direct and blatant approach to a more subtle tactic to advance their goals.

How Jihadist Organisations Adapt and Survive: The Case of the ISKP

While several jihadist organisations in different parts of the world have been able to adapt and survive new challenges in the environment they operate in, perhaps, one of the most interesting cases concerns the trajectory of the Islamic State Khorasan Province (ISKP) after August 15, 2021, and the return of the Taliban in control of Afghanistan. The group has been able to survive between Afghanistan and Pakistan while spreading its influence into Central Asia, and framing new global ambitions in orchestrating, coordinating, or inspiring attacks in the region, and in the West.

The ISKP has undergone several changes since its inception in 2014-2015. The group transitioned from a group mostly born out of disgruntled Pakistani Taliban factions into a more heterogeneous organisation compromising Pakistani, Afghan, and Central Asian nationals, focusing on territorial conquests first, and then, after 2020, on dispersed guerrilla warfare and, finally, after 2022, on low-intensity, high-value and complex operations.[60]

Consequently, the ISKP military strategy evolved over time due to the different periods of time and environments in which it operates, both in terms of countries—as in the cases of Afghanistan and Pakistan—as well as in terms of regimes within a country—like in Afghanistan during and after the republican regime.[61] After August 2021, the ISKP changed its approach to its insurgency as it had to reassess itself while solely confronting the Islamic Emirate, which gradually transitioned from another insurgent movement to a functioning government.[62] Hence, initially, ISKP patterns of attacks following August 2021 did not differentiate between

those during the previous republican government.[63] However, due to the Afghan Taliban's heavy CT pressure against the group, the ISKP was forced to change its strategy. The group's number of attacks gradually dwindled between 2022 and 2023, with a sharp decrease in the latter year, situating itself on a similar trajectory for 2024.[64]

The Afghan Taliban effectively crippled the ISKP through a series of coordinated and successful CT operations in 2023. The Taliban killed top ISKP commanders and ideologues, such as Qari Fateh, Abu Saad Muhammad Khorasani, Qais Laghmani, and many others. As a result, in 2023, the ISKP dropped to the lowest level ever, with 45 claimed attacks between Afghanistan and Pakistan.[65]

Consequently, fewer but deadlier attacks became the new trend, with high-value targets being selected by the ISKP, including Taliban officials; religious figures; and foreign nationals.[66] Geographically, the ISKP first shifted its focus to the north of Afghanistan between 2022 and 2023, including the Badakhshan and Kunduz provinces, while subsequently, in 2024, repositioning itself in Kabul, Kandahar, Ghor, Bamiyan, and Nangarhar provinces, showing that while the group claims less and low-scale attacks, it is still capable of expanding its areas of operations, possibly shifting militants across the country, or by retaining sleeper cells in different regions.[67]

In Pakistan, the ISKP continued to heavily expand in different areas of the country, demonstrating that while the group might be suffering casualties in Afghanistan, it has been able to devote resources to orchestrating some deadly attacks in the neighbouring country. Thus, in the areas of the Khyber Pakhtunkhwa region—such as Khyber tribal district, Bajaur tribal district, and Peshawar as well as in Balochistan province's locations, such as Quetta and Mastung—the ISKP has been targeting security forces; the Shia community; and rival religious scholars belonging to Pakistan's right-wing religious party, Jamiat Ulema-e-Islam-Fazl (JUI-F).[68] Recently, and similar to Afghanistan, the ISKP has been able to extend its presence also in North and South Waziristan and Karak, in areas where it had ceased to claim attacks for years.[69]

At the same time, the ISKP's ability to adapt and reposition itself following a crackdown by the Afghan Taliban is inherently connected to the group's transnational soul, which allows the group to shift to different areas, going underground not only on Afghanistan's soil but also in neighbouring countries.[70] Paradoxically, the more the ISKP appears to be weaker in Afghanistan and Pakistan, the more it attempts to expand its external operations capacity.[71] The ISKP slowly

but steadily built its own media apparatus which keeps expanding and reaching out to constituencies as well as possible recruits and admirers in different parts of the globe—from Central and South Asia to Europe and the USA. This expanded global scope is directly linked and expressed in the ISKP's local target selection, and its increased prioritization of external operations. In total, its regionalization and internationalization strategies consist of an expansion in multilingual propaganda scope, intensification of attacks on foreign interests and nationals in its conflict theatre, and a markedly increased prioritization of external operations and efforts to incite supporters to violence abroad.[72]

As seen in the previous sections, the ISKP's global ambitions have led several countries and analysts to suspect its more or less direct involvement in some major international plots, such as the Santa Maria Church's attack in Istanbul; attacks in Iran's Fars and Kerman province; and in Moscow's Crocus City Hall attacks.[73] While it would be wrong to assume that only the ISKP is responsible for external operations by the Islamic State, it is evident that ISKP has been able to frame international narratives through its robust propaganda machine that has lured individuals into carrying out lone-wolf attacks and, possibly, to reinforce the transnational Islamic State's network(s) across Europe, Turkey, Iran, Central Asia and Afghanistan, and Pakistan—all tasked with planning international attacks.[74]

Conclusion

Militancy, and specifically, jihadist militancy is not a static phenomenon. Jihadist organisations have been historically framing a strategy and a long-term vision tied to ideological aspects and practical goals. However, their tactics and approaches generally fluctuate in accordance with the time, geography, and the changing environment in which they operate, exposed to international, regional, and local dynamics. These elements are key to understanding how militant organisations evolve. They are paramount in framing the policy guidelines necessary to tackle them. One major fault that generally governments and security apparatuses incur is the lack of reading and understanding of the messages as well as the inherent grievances militants appeal to in order to propagate their struggle, and remain relevant in the political discourse. Since jihadist groups strongly rely on propaganda to attract funds and recruits for their activities—to the extent that propaganda warfare is complementary to kinetic activities—by carefully examining jihadist propaganda it is possible to pick up trends and directions of the militancy path.

Today, the jihadist landscape is possibly undergoing a transitory phase from the post-9/11 period and the rise to power of the Islamic State in 2014, to a new chapter of militancy that might have huge repercussions on regional and international dynamics. The transition of the Afghan Taliban from insurgency to a functioning state; the intra-jihadist competition and the quest for proto-states in Africa; the adoption of tactics by jihadist groups that were usually performed only by states—such as the use of proxies; and a new phase of dispersed individual jihad might be all signs of the next chapter in the world of jihadist militancy.

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4

Nuclear Deterrence in the Age of Major Power Conflict

D B Venkatesh Varma

The three main categories of Weapons of Mass Destruction (WMDs)—nuclear, chemical, and biological—have significantly shaped global security dynamics. Among these, nuclear deterrence has been the central feature in the strategic interactions of major powers, and a cornerstone of the post-World War II international order. This order, which has been largely founded on the concept of nuclear deterrence, is now facing unprecedented challenges, leading to instability and posing new threats to international peace and security.

The hope for a peaceful and negotiated transition to a new, multipolar world order is fading. Current trends in major power conflicts raise concerns about a fundamental question: can nuclear deterrence moderate geopolitical conflict amongst the nuclear armed powers, and thus prevent escalation of a nature that increases the risk of the use of nuclear weapons? Rebuilding international peace and security without disrupting the nuclear taboo established since 1945, which prohibits the use of nuclear weapons is, thus, an imperative priority.

A key feature of current global instability is that while nuclear deterrence had been successful in preventing direct conflict among nuclear powers during the Cold War period, its utility in doing so in the post-Cold War period has steadily eroded. This erosion has increased instances of indirect conflicts, hybrid wars, and proxy wars. This paradoxical situation requires further examination.

Chemical and Biological Weapons

Although chemical and biological weapons have not played as central a role in deterrence as nuclear weapons, they have nevertheless influenced global threat perceptions. These weapons are of particular concern due to the non-universal membership of key international conventions, such as the Chemical Weapons Convention and the Biological Weapons Convention, the lack of adequate verification for clandestine programs (for example, in Syria), and the proliferation risks to terrorist groups. Furthermore, technological advances present significant challenges to maintaining the international legal norm against the acquisition and use of chemical and biological weapons. The politicization of the work of the Organization for the Prohibition of Chemical Weapons (OPCW) and the Biological Weapons Convention (BWC) has eroded trust among States, hindering effective cooperation on these WMDs. In the case of nuclear weapons, there has been a steady weakening of the non-proliferation and disarmament regime, reflected in the deep divisions amongst the States party to the NPT, and in the tardy implementation of its provisions.

Six Phases of Nuclear Deterrence

A critical issue in the global strategic landscape is the erosion of nuclear deterrence, which has been in progress since the mid-1980s, accelerating after the collapse of the Soviet Union. The weakening of nuclear deterrence, which began to surface more clearly in the past decade, represents a grave challenge to global stability. Six distinct phases of nuclear deterrence can be identified from 1945 to the present, each shaping the nature of international relations during its time.

The first phase, from 1945 to 1949, marked the advent of nuclear weapons, and the period of US nuclear monopoly until the Soviet Union developed its own nuclear capabilities in 1949. The geopolitical structure of this era was shaped by agreements among the victorious powers of World War II, with nuclear deterrence gradually emerging as a critical component of this balance. A geopolitical agreed balance between the USA and the then Soviet Union in the trans-Atlantic strategic space acted as the foundation on which subsequent arrangements of nuclear deterrence were built.

The second phase, from the early 1950s to the Cuban Missile Crisis in 1962, was characterized by major power interventions, such as the Korean War; and the avoidance of direct conflict between the USA and the Soviet Union. During this period, the concept of nuclear deterrence evolved, influenced by game theory, the

growing destructive potential of nuclear weapons, and the proliferation of long-range delivery systems.

The third phase, from the late 1960s to the late 1980s, marked the maturity of nuclear deterrence. This period saw the refinement of nuclear doctrines, the development of bilateral arms control agreements with focus on preventing a surprise, disarming first strike, and promoting arms control and crisis stability. Non-Proliferation efforts were taken forward through restrictions on possession of nuclear weapons as seen in the NPT.

The fourth phase, beginning with the end of the Cold War and the collapse of the Soviet Union, witnessed US unipolar primacy, shifting the focus of nuclear deterrence towards proliferation threats posed by emerging nuclear powers like India, Pakistan, and North Korea. However, the erosion of traditional arms control agreements accelerated as the USA no longer felt constrained by Cold War-era treaties, and NATO expansion began to undermine the geopolitical foundations established in 1945.

The fifth phase, starting around 2008, marked the high point of US nuclear primacy. The US nuclear arsenal modernization program, which began with the New START Treaty in 2010, came at the cost of significant investments in updating nuclear capabilities. The rise of a more assertive China, and Russia's growing dissatisfaction with its strategic position became more apparent, with President Putin's 2007 Munich speech marking the beginning of a more aggressive stance against perceived Western strategic encroachment.

The sixth and current phase began with Russia's military intervention in Ukraine in 2022. While the invasion of Ukraine violated principles of sovereignty and territorial integrity, it was not an unprovoked action. This ongoing conflict has contributed significantly to the destabilization of global peace and security, with the erosion of nuclear deterrence becoming more pronounced as a result.

Deterrence and Nuclear Weapons

The primary instrument of deterrence between the major powers—namely, the USA and the Soviet Union, and later Russia—has been nuclear deterrence, which was based on the idea of parity and arms control agreements. For much of the Cold War, this nuclear balance allowed for restraint, and the avoidance of direct geopolitical conflicts in areas of vital interest to both powers. However, the collapse of the Soviet Union and the weakening of Russia's strategic position, coupled with the expansion of NATO, began to unravel this balance, leading to the gradual erosion of nuclear deterrence.

Russia and the West

The geopolitical tension between Russia and the West has been a key driver of this erosion. Russia's nuclear doctrine, which once played a pivotal role in protecting its strategic interests, failed to prevent NATO's expansion, or to safeguard its sphere of influence. The conflict in Ukraine has shown that possessing nuclear weapons does not guarantee security against the geopolitical manoeuvres of other major powers. The slow burn expansion of NATO towards Russia's borders, despite it possessing the largest nuclear arsenal and its repeated warnings, initially showed Russian weakness and, thereafter, led to the grave miscalculation on part of the USA and NATO—the main supporters of Ukraine, that Russia would not use force to defend what it perceived its vital interests on its periphery. The situation changed fundamentally with Russia's invasion of Ukraine in February 2022.

Russia-Ukraine Conflict: The Nuclear Dimension

The use of nuclear weapons in the Russia-Ukraine conflict has remained a subject of ongoing debate. While Russia has avoided using nuclear weapons, its messaging has had significant strategic impact on battlefield operations. Russia has increasingly relied on its nuclear messaging to deter Western support for Ukraine—but only with partial success. Gradually, the USA and NATO's support for Ukraine has escalated, both in terms of quality and the sophistication of weapons provided to Ukraine, including those capable of targeting critical targets in Russia, such as the Engels Air base which hosted Russian strategic bombers as well as providing long range attacks missiles which rely on NATO targeting support. In view of the fact that Russia is a nuclear power, it can be argued that the USA may have avoided deploying troops for direct conflict, or the imposing of no-fly zones, and slowed down advanced weaponry supply, including long range weapons that can hit strategic targets in Russia while providing material, financial, intelligence, and other forms of support that has sustained the Ukrainian war effort. However, this restraint has eroded over time, and a creeping escalation has ensued. Paradoxically, Russia's partial success in moderating US support for Ukraine has led to the prolongation of the war, with major geopolitical impact in other regions as well.

The US Administration finally announced it was permitting Ukraine to use American supplied long-range missiles (ATACMS) for hitting targets in Russia on 18 November 2024. The UK and France followed suit. Ukraine has chosen to be a proxy power in the conflict between Russia and the USA. The war has escalated vertically during the conflict since 2022. It is now poised to escalate horizontally

as well, with the alleged presence of DPRK troops in Russia, and reverse proliferation to Russia from DPRK, Iran and others. US and NATO assets are increasingly getting involved in the conflict.

From the Russian point of view, its nuclear doctrine was inadequate to protect its interests short of the use of military force in the war with Ukraine. However, Russian pronouncements, including by President Putin in Feb 2022 and on several occasions since then, warned only of partial success against arms supplies and other support from the USA and other NATO members to Ukraine.

The reason why Russia has avoided mirror escalation in retaliation to provocations is that it would divert attention and resources away from its primary strategic objectives in the Ukraine conflict. Thus, the nuclear dimension of Russian military power has offered only a partial remedy for its conventional objectives. In the case of the Kherson withdrawal, in September-November 2022, the alleged plans of Russia to use nuclear weapons—protested strongly by the USA and other countries, including China and India—may have facilitated the withdrawal of Russian forces across the Dnieper River. Hence the nuclear factor may have cut both ways: Russia did not use tactical nuclear weapons; but its threat did impact the battlefield operations somewhat, although it did not materially alter the escalation dynamic in the conflict.

The New Russian Nuclear Doctrine

The New Russian Nuclear Doctrine of 19 November 2024 formalised Russia's policy because of the internal review on the lessons of the Ukraine conflict. The New Nuclear Doctrine spelt out that the circumstances of nuclear weapon use by Russia would now include the use of conventional weapons that create a 'critical threat' to its sovereignty or territorial integrity; the use of nuclear weapons against an adversary targeting Russian forces based outside its territory; Belarus as a nuclear protected ally; and, most significantly, resist a massive attack of aircraft, missiles, and drones crossing into Russia. It lowers the nuclear threshold by identifying 10 military risks that could evolve into military threats. Significantly, the new doctrine states that aggression against Russia and Belarus by a non-nuclear state, with the participation or support of a nuclear State, is considered as their joint attack. Russia subsequently tested conventional medium range MIRV payloads with hypersonic capabilities in combat conditions against targets in Ukraine.

Nuclear Lessons from the Russia-Ukraine Conflict

The evolving nature of conflict has highlighted the limitations of classic nuclear deterrence, which is increasingly challenged by new forms of warfare, including hybrid and proxy conflicts, and emerging domains such as cyber and space. These developments underscore the need for a comprehensive understanding of nuclear deterrence in the context of multi-domain conflicts. The experience of the Russia-Ukraine war suggests that nuclear weapons alone cannot substitute for conventional military strength, and the integration of nuclear and conventional forces is crucial for maintaining deterrence in the modern strategic environment. The conflict also shows the new dynamics of nuclear signalling with and without overt nuclear force deployments, attacks on nuclear power plants, testing of new weapons under combat conditions, client and proxy State dynamics in the nuclear field with respect to the USA and Ukraine, and a reversal of nuclear and conventional deterrence dynamics in protracted war conditions. The erosion of the NPT based non-proliferation regime may follow soon, if the nuclear brinkmanship between the nuclear armed States continues unabated, opening the doors for rampant and unrestrained nuclear proliferation, leading to perhaps the complete collapse of the nuclear order.

Lessons for India

In the context of India as a nuclear power, with growing influence in global affairs, the erosion of nuclear deterrence presents both challenges and opportunities. India's nuclear doctrine, particularly its No First Use (NFU) policy, has served the country well and continues to do so. However, considering the evolving strategic environment, India must maintain a flexible approach, ensuring its nuclear capabilities remain robust while adapting to the complexities of multi-domain conflict. India's nuclear posture must be carefully calibrated to respond to emerging threats, including the growing military capabilities of China and Pakistan. At the same time, India, which has an interest in preventing the complete collapse of the nuclear order, should continue to support international efforts towards nuclear restraint, and help reducing nuclear dangers through addressing specific nuclear risks, both regionally and at the multilateral level. A new nuclear order for the new multipolar and multidomain age is needed for which India could take relevant initiatives.

Conclusion

In conclusion, the global strategic landscape is undergoing significant changes. The USA is an overextended power facing domestic challenges, while Russia's position remains unstable despite its actions in Ukraine. China's rise presents new challenges, and the increasing use of proxies in global conflicts highlights the shifting nature of warfare. As a rising power, India must prioritize strategic autonomy and independence, ensuring its security through a well-rounded defence strategy that incorporates both nuclear and conventional capabilities. While partnerships with other nations remain important, India must not compromise its strategic autonomy in pursuit of external balancing; instead, it should focus on its own path to becoming a global power by the centenary of its independence.

The classical nuclear order is in deep crisis. The erosion of nuclear deterrence is accompanied with the greater propensity of States to use force to gain an upper hand in the multifarious conflicts involving non-nuclear dimensions. Hence the belief that the nuclear dimension, once insulated from other dimensions of conflict, would guarantee deterrence may no longer be true. Assessing nuclear deterrence in the new context of multi domain conflict is a complex but necessary task. These lessons should be studied, and the relevant conclusions incorporated into our security frameworks.

PART II

Organisational Agility: Meeting the Challenges of Modern Wars

5

Organisational Agility: Jointness a Necessity for Modern Warfare

Rajeev Sachdeva

Jointness in Warfare[1]

Modern warfare involves operations across multiple domains—land, sea, air, space, and cyberspace. No single military branch can effectively cover all these domains. Jointness allows for coordinated action across domains to achieve strategic objectives.

Technological advancements. Rapid technological progress has led to sophisticated weapons systems and communication networks that often require integration across services. For example, air defence systems may need to integrate with naval platforms or cyber operations may support ground manoeuvres.

Resource optimisation. In an era of constrained defence budgets, jointness allows for more efficient use of resources. Shared capabilities, training, and logistics can reduce redundancies and costs across services.

Speed and agility. Modern conflicts often require rapid response and adaptability. Joint operations allow for quicker deployment of the most appropriate forces and capabilities, regardless of which branch they belong to.

Information superiority. The ability to gather, process, and disseminate information

quickly is crucial in modern warfare. Joint operations facilitate better information sharing, and a more comprehensive common operational picture.

Interoperability with allies. As many military operations are conducted in coalition environments, jointness within a nation's forces promotes better interoperability with allied nations' militaries.

Asymmetric threats. Modern adversaries often employ asymmetric tactics that do not conform to traditional military boundaries. Joint operations provide the flexibility to respond to diverse threats effectively.

Strategic deterrence. The ability to project a unified, multi-domain force serves as a powerful deterrent to potential adversaries.

Inter-Service Cooperation[2]

Inter-service cooperation refers to the collaboration and coordination between different branches of a country's armed forces—typically the Army, Navy, and the Air Force (and in some countries, the Marine Corps or the Coast Guard). Inter-service cooperation is crucial in modern warfare, where conflicts often span multiple domains (land, sea, air, space, and cyberspace) simultaneously. It allows for more flexible, adaptable and powerful military responses to diverse threats and operational requirements.

This cooperation involves:

- Shared planning and strategy development.
- Joint operations and exercises.
- Sharing of resources, intelligence and capabilities.
- Coordinated training programs.
- Unified command structures for specific missions or regions.

Military Integration

Military integration is as important as military jointness, and these two are related but distinct concepts in modern military thinking.

Military Jointness. This refers to the ability of different service branches to work together effectively in operations. It is about coordination and interoperability in the field.

Military Integration. This goes a step further, implying a more fundamental merging of capabilities, doctrines, and even organisational structures. Integration suggests

a deeper level of cohesion where the lines between services become less distinct in certain areas.

Complementary Strengths. While jointness allows each service to bring its unique capabilities to bear in a coordinated manner, integration can create new capabilities that transcend traditional service boundaries.

Resource Efficiency. Integration can lead to a more efficient use of resources by reducing redundancies between services.

Adaptability. An integrated force may be more adaptable to rapidly evolving threats and operational environments.

Strategic Thinking. Integration promotes a more holistic approach to defence strategy, moving beyond service-specific perspectives.

Technological Synergy. As military technology becomes more complex and interconnected, integration becomes crucial for leveraging these technologies effectively.

Cultural Change. While jointness improves cooperation, integration can foster a shared military culture that transcends individual service identities.

However, it is worth noting that achieving true military integration is often more challenging than jointness. It requires overcoming deeply ingrained service cultures, traditions, and sometimes conflicting priorities.

Indian Leadership and the Concern[3]

On 15th August 2019, from the portals of the Red Fort, the Prime Minister announced the post of the CDS, and said that it was a compelling task of the Government to do so. Thus, on 1st January 2020, the Indian Armed Forces got its first Chief of Defence Staff.[4] The Prime Minister said, national security was of immense importance, and we should

> …take timely steps towards reforms...
>
> Deliberations are on since [a] long time to bring reforms in military structures, military power and military resources. Several commissions have been formed, and all reports have brought to light [the] same issues with minor variance…
>
> There is indeed coordination between three Services. … They also strive for modernity in their own way…

> [The]World is changing today, as also the scope and nature of war. It is becoming technology driven … India too should not have fragmented approach. Our entire military power will have to work in unison and move forward.
>
> Things cannot move smoothly if any of the Services is ahead of the balance two Services. All should move simultaneously at the same pace. There should be good coordination, and it should be relevant with the hope and aspirations of our people. It should be in line with the changing security environment in the World today.
>
> Today we have decided that we will now have a Chief of Defence Staff—CDS, and after [the] formation of this post, all the three forces will get effective leadership at the top level.
>
> The CDS is an important and compelling task in our dream to reform the strategic pace of Hindustan in the World.[5]

The Challenges[6]

On 15th August 2019, in his speech from the portals of Red Fort, Prime Minister Modi expressed his concern about Jointness and Integration, which can only be achieved once the three Services fuse their intelligence to identify a common threat perception, amalgamate their assets, create an interoperable environment, view a common battle field milieu, have a seamless connectivity, write a joint perspective plan and, finally identify a joint capability required to counter the common threats leading to future wars.

Fuse Intelligence to Identify National Threat Perception[7]

There are four Military agencies gathering intelligence, and the repository of intelligence information is respectively secured with the four individual Services, namely, the Indian Army, the Indian Navy, the Indian Air Force, and the DGDIA at HQ IDS. Even though the relevant intelligence is shared amongst the Services and the NSCS, it still restricts itself to Service specific threat perceptions. However, a single Joint National threat perception needs to be identified from the intelligence gathered by the respective Services, and should be amalgamated as a National Military Threat under the CDS at the DIA.

Seamless Connection between the Three Services

Connectivity is derived from the medium of terrestrial and space spectrums, sensors, and networks. In an AI, M2M, and IOT environment, the Armed Forces are entangled into so many sensors, networks, and mediums which have hardened walls, and they do not let one Service seamlessly connect with another Service.

Spectrum is scarce, and commercial usage has promised US$1 trillion to the Indian US$ 5 trillion dream. As per the National Frequency Allocation Plan-81 (NFAPF-81), Defence was the major user of spectrum across the full frequency bands. However, with the invention of mobile telephony, from NFAP-99 onwards, Defence is no longer the major user. Thus the need to integrate, use the spectrum jointly, and reduce the networks, mediums, and sensors by not only migrating to the new way of communicating but also by integrating the resources and the output of these sensors. Networking and communication have to be simplified, and be redesigned to get the best results and be cost effective.

Space Communication

During the 18th South Asian Association for Regional Cooperation (SAARC) summit held in Nepal in 2014, the Indian Prime Minister, mooted the idea of a satellite serving the needs of SAARC member nations as a part of his Neighbourhood First policy.

On 5th May 2017, the Indian Space Research Organisation (ISRO) launched the South Asia Satellite, GSAT-9, a geostationary communications and meteorology satellite, for the SAARC region. Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, and Sri Lanka are the users of the multi-dimensional facilities provided by GSAT-9 satellite.

The GSAT-7/7R are Naval Satellites; the GSAT-7A is an Air Force Satellite; and the GSAT-7B will be an Army Satellite. The question that arises is: when India can bring the neighbours on one satellite, then how can the Satellite communication in the Armed Forces have a Services specific tag to satellites? The designing, manufacturing, and then the launching of a satellite is done individually by each Service. The time has come to join up on the drawing board, and the military needs to economise even on this resource.

Unmanned Aerial Systems (UAS)[8]

Unmanned aerial systems (UAS), Unmanned combat aerial vehicles (UCAV), or combat drones are equipped with advanced hardware, such as sensors and cameras, and are remotely operated without necessarily risking the lives of soldiers. This has revolutionised military operations which can now destroy maximum enemies but sacrifice a minimum number of lives.

In India, the military has been using drones for various purposes, like reconnaissance and surveillance, for a long time, and have been using both

indigenous and imported drones for these purposes. These drones have been used in counter-insurgency and counter-terrorism operations, as well as for reconnaissance and surveillance, payload delivery, electronic warfare, search and rescue, border and coastal security, and training.

The world's largest drone festival, held in May 2022, was inaugurated by the Indian Prime Minister, who shared his confidence in the young talents of India, and India's rising capability in the drone sector. However, like the satellites, the three Services, despite the purchase from the same OEM, own and operate their respective UAS. However, they should seamlessly connect and share the real-time information with one another.

Supply Chain Management

To give a fillip to the country's logistics sector, in September 2022, a National Logistics Policy (NLP)[9] was launched as the country's first holistic approach for this US$ 200 billion sector. This policy will bring in an integrated and technology enabled approach to logistics operations to bridge the efficiency gap.

The key objectives would be to make Indian logistics competitive in terms of global standards. Some key thrusts include, Integration of the Digital System (IDS), a Unified Logistics Interface Platform (ULIP), Ease of Logistics (ELOG), and a System Improvement Group (SIG).

New eco-friendly waterways are being setup. 40 air cargo terminals have been setup to facilitate exports; 30 airports have cold storage facilities; and 35 multi modal logistics facilities are being setup. The turnaround of container vessels at ports has been reduced from 44 hours to 26 hours. India is aiming to bring down the logistics cost from 13-14% of GDP to single digits. The Prime Minister said, 'It is a low-hanging fruit to be globally competitive'.

The IAF has its own Integrated Material Management On-line System (IMMOLS),[10] an on-line Material management system that ensures transparency, and improves planning across the Indian Air Force (IAF). IMMOLS is used for the transparency of inventory, the location of items, the ideal places to move them to, the monitoring of the trend of consumption, and the planning and calculation of procurement accordingly. These have made the IAF more equipped, agile, and robust to effectively handle any contingencies, and benefit from better cost management.

The Indian Navy has its own Chief System Administrator Integrated Logistics Management System (CSAILMS). It is the lead organisation for the all-system

Administrator which is located in Material Organisations at various locations in the country, and is responsible for the promulgation of technical and administrative directives for the maintenance and upgradation of the inventory management software of the Indian Navy. In addition, the systems Administrator also monitors the functioning of the Integrated Clothing Management System (ICMS) and the Integrated Victualling Management System (IVMS).

The Armed Forces have established three Joint Logistics Nodes (JLN): at Mumbai, Guwahati, and Port Blair. These JLNs will provide integrated logistics cover to the Armed Forces for their small arms ammunition, rations, fuel, general stores, civil hired transport, aviation clothing, spares, and also engineering support in an effort to synergise their operational efforts. Advantages accruing from this would be in terms of saving of manpower, the more economical utilisation of resources, besides financial savings.

This is the precursor to the joint logistics command which could be planned. This is imperative for the optimisation of the combat potential of integrated theatres, because over a million lines have to get integrated. It will be quite a task as the IMMOLS and CSAILMS are not integrated, and thus the visibility of the millions of lines of common inventory remains within each service.

The nation is joining up through the NLP, and the Services need to think jointly and have a joint supply chain management system. The starting point will be to have a common codification for the millions of lines of equipment, which are same but have different nomenclature on the three E-Systems of the respective Services.

Joint Capability Building[11]

In 2012, the Services drew out their respective Long Term Perspective Plans for 15 years, which were integrated at HQ IDS as the Long-Term Integrated Perspective Plan 2012–27, commonly addressed as LTIPP 2012–27. The DRDO, thereafter, drew out their Technology Perspective and Capability Roadmap in 2015, in sync with the LTIPP.

A simple introspection would tell us if we have been able to fill all the voids as envisaged, and has India become self-reliant in technology to fill in these voids as given in the Technology Perspective and Capability Roadmap (TPCR) of the DRDO. In his speech from the portals of Red Fort Prime Minister Modi said,

> Things cannot move smoothly if any of the Services is ahead of the balance two Services. All should move simultaneously at the same pace. There should

> be good coordination, and it should be relevant with the hope and aspirations of our people. It should be in line with the changing security environment in the World today.[12]

CDS has already initiated the Integrated Capability Development (ICAD), towards this new joint approach, and is synchronised with the anticipated budgetary allotment for the next 10 years.

Revolution in Military Affairs (RMA)[13]

After the creation of the Integrated HQ on 1st Oct 2001, the announcement of the post of the Chief of Defence Staff (CDS) and the Department of Military Affairs (DMA) was a historical moment for the Armed Forces, and brought to closure one of the longest standing demands of the Armed Forces for decades.

The CDS wears a triple hat.

- Firstly, that of the Chief of the Defence Staff (CDS).
- Secondly, the permanent Chairman of the Chiefs of Staff Committee (COSC).
- Thirdly, Secretary of an independent Department of the Ministry of Defence the Department of Military Affairs (DMA).

The Government of India, as of 1st Jan 2020, carved out the Allocation of Business (AOB) Rules for the Secy DMA,[14] by transferring some of the AoB of the Defence Secretary to the Secretary DMA. These are,

- The Armed Forces of the Union, namely, Army, Navy and Air Force.
- The Headquarters of the Ministry of Defence comprising of Army, Naval, Air and Integrated Defence Staff Headquarters.
- The Territorial Army.
- Works relating to Army, Navy and Air Force.
- Procurement excluding to the Services except capital acquisition.

The New AOB rules towards Nation building were also included for the Secy DMA/CDS. These are,

- Promoting jointness in procurement, training, and staffing for the Services through joint planning and integration of their requirements.
- Facilitation of restructuring of Military Commands for optimal utilisation of resources by bringing about jointness in operations, including through establishing of Joint/Theatre Commands.
- Promoting the use of indigenous equipment by the Services.

Apart from being the Secretary of a newly created Department, the Department of Military Affairs (DMA), the CDS is also the Permanent Chairman of COSC, and is the Principal Advisor to the Government on all the matters pertaining to the Military. The Allocation of Business Rules for the DMA also tasks the CDS to restructure the Military Organisation, and create Theatre Commands.

Conclusion

The creation of the post of the Chief of Defence Staff and the Department of Military Affairs was a historical moment for the Indian Armed Forces. It has infused the Military into the National Security Mechanism. As of 1st Jan 2020, the Government of India has carved out the Allocation of Business (AOB) Rules for the Secy DMA, directly tasking the CDS to restructure the Military Organisation and create Theatre Commands.

This can only happen firstly, with whole Nation approach; and, secondly, if the three Services join up at the drawing board, and create an interoperable environment, fuse intelligence, create a common battle field milieu, have a seamless connectivity, write a joint perspective plan, and create joint National Military capability. To operationalise and fight a war through a Joint Theatre Command, the three Services will have to start thinking together, plan together, and also train together.

NOTES

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6

Framework for Enhancing Jointness in the Armed Forces

Vivek Chadha

Contextualising Jointness

The debate over the relevance of jointness and integration is old. Even in countries where its practical introduction dates back to World War II, an ideal state of effectiveness is yet to be achieved.[1] Ironically, as armed forces seek clarity on the implementation process, the very definition of these terms remains ambiguous. There is little consensus on these terms, with jointness and integration tending to be used interchangeably. Yet, these terms are distinct, and play an important role in the effectiveness of any organisation. Militaries are no exception to this reality.

The Joint Doctrine of the Indian Armed Forces attempts to explain the two terms. Jointness 'denotes an optimised capability to engage in Joint War-Fighting. … With Jointness, a high level of cross-domain synergy is attained.' The Doctrine relates the term integration to the 'integration of 'processes' across all operational domains of land, air, maritime, cyberspace and aerospace, towards optimisation of costs and enhancing readiness.' It suggests collaboration with other instruments of national power. Integrated military power, the Doctrine says, 'is enabled through inter-woven structures that are integrated and deployed viz, human, institutional and doctrinal.'[2] It suggests that jointness aims to achieve synergy, while integration streamlines the process for improved effectiveness. This usually involves the process of restructuring. Anit Mukherjee proposes that jointness is synergising the

capability of the armed forces. According to him, this can be achieved in two ways: through coordination and integration.

> 'The coordination approach allows maximum autonomy to the services and does not require resolution of potentially contentious issues over turf, roles and, most importantly, command and control. Jointness is left to the discretion of the service commanders. On the other hand, the integrated model of jointness is one in which there is 'unity of effort' wherein the three services operate under a single commander.'[3]

In other words, integration is one of the ways to achieve jointness, with the other being merely through coordination, wherein, the requirement of placing the armed forces under a single commander can be precluded. Further, Mukherjee argues that, given the inherent service-centric approach of the military, civilian intervention is needed to pursue it, and jointness is best achieved through an integrated rather than a cooperative framework.

Ladhu R. Choudhary uses the Jackson Model to evaluate jointness in the Indian context on four parameters: 'military activities, namely, operational, organisational, educational and doctrinal.'[4] As part of this model, the number of joint operations, organisations, command and control structures, professional military education institutes, doctrinal publications, organisations tasked with developing joint doctrine and reducing duplication through joint structures form a part. Choudhary argues that jointness is 'aimed at de-institutionalising service-specific culture through conceptual, organisational, doctrinal, and educational military innovations and change.'[5] The Jackson model provides a viable option to assess the levels of jointness through different facets of organisational functioning. However, as the US example indicates, even the most integrated military structure in the world may still not deliver on the expected promise of jointness. The mere creation of an organisational structure, a joint training institute, or the creation of a joint doctrine is not a guarantee for effectiveness in operations.

John J. Hamre provides an understanding of events that eventually led to the passing of the Goldwater-Nichols Act of 1986. The proverbial straw that broke the camel's back was the failure of Operation Eagle Claw in 1980. The operation to rescue 52 diplomats was aborted due to the poor implementation of a joint operation. This was reinforced yet again during Operation Urgent Fury in Grenada where the Marine Corps and the Army operated in water-tight compartments, to the extent that they were forced to use commercial telephones to contact each other.[6] In the case of the USA, the challenges did not emerge from the lack of

integration; these came from the lack of jointness (the differences will be discussed in the next section). In essence, the reforms strengthened the purple element of the integration process, thereby giving it a qualitative impetus to achieve jointness. This was done by strengthening the appointment of the Chairman Joint Chiefs of Staff Committee and the Vice Chairman to improve coordination, and mandated the requirement of holding joint services appointments for being promoted to flag ranks.

Charles Davis and Kristian E. Smith visualise jointness more from a psychological rather than a physical perspective. They describe it thus: 'Jointness is a psychological state characterized by the willingness of members of each branch of Service to trust, collaborate, and operate interdependently with each other to accomplish a shared mission'.[7] This would suggest that even though the armed forces are integrated by appointing a Chief of Defence Staff and creating Theatre Commands, it will not guarantee jointness in operations unless the larger interests of effective force application supersede service interests. The US experience in Iran reflects this reality. More recently, the Russian example in Ukraine suggests that the physical integration of forces does not necessarily yield the requisite results in the absence of jointness.[8]

There are differences in how jointness and integration are perceived by academics and practitioners alike. For the purpose of this essay, the term integration will be related to the creation of physical structures that bring elements of different services under a single military commander. As an illustration, the cyber and space agencies bring all three service assets under a single commander as does the Andamans and Nicobar Command (ANC). These are examples of integration. In the future, the creation of integrated geographical commands will become the flag bearers of this concept, as is the case with similar initiatives like the US Indo-Pacific Command or the Chinese Western Theatre Command. However, the creation of a physical structure is not necessarily enough to ensure jointness unless this is accompanied by supporting initiatives that nurture, support, encourage, and ensure cohesive functioning towards a designated objective. The jointness of elements, structures, processes, and procedures facilitates this coherent functioning. Even if jointness is psychological, this feeling has to manifest through a series of actions and steps to achieve a level higher than what currently prevails. This essay will suggest certain initiatives that can facilitate the process of enhanced jointness.

The Jackson model provides a good beginning since it lays down the four major categories for enhancing jointness. As mentioned earlier, this includes

conceptual, organisational, doctrinal, and educational military innovations and change. Instead of seeking specific initiatives under each of these categories, it would be useful to underline the core functional processes of the armed forces, and see if these relate to the four attributes.

If one were to broadly classify activities in any domain, including the military, commencing from the planning stage until effective implementation, these would possibly include a joint vision, joint planning, joint training, joint capability development, joint support, joint operations, and a joint follow-up. Amongst these, planning, training, and the actual conduct of operations receive support from several agencies, from the inception till the culmination stage of an operation. Similarly, the capability development process is a continuous activity that goes on over a long period, given the long gestation period involved. If these activities are co-related with the conduct of an actual military campaign, the implications of jointness, and its inescapable imperative become evident.

India's Record of Jointness in War

India has displayed a mixed record of jointness in military operations since Independence. Picking any single war, conflict, or counter-terrorism campaign can throw up contradictory indicators of military effectiveness. This essay does not intend to undertake a detailed deep dive into the history of each war, which is beyond the immediate scope of the subject under discussion. Instead, it aims to highlight certain key attributes in each instance to reinforce a strength, or a weakness, that helps identify the key attributes of jointness from India's experience.

The 1947–48 war witnessed excellent joint operations conducted by the Army and the Air Force. This commenced with the landing at Srinagar on 27 October 1947.[9] The operation that involved a large fleet of civil aviation aircraft for landing 1 Sikh at Srinagar was itself an example of jointness as a national effort. Soon thereafter, the Battle of Shalateng witnessed an effective joint operation between the two services on 7 November 1947.[10] The two services successfully beat back the enemy columns advancing towards Srinagar in a decisive battle that involved the infantry, armour, and fighters. This was even though the concept of integration and jointness was at a nascent stage, and joint structures were still to evolve in India.

India's strategic failure to read the situation against China during the years preceding the 1962 India-China War is well documented. This is accompanied by the leadership's inability to prepare the country for conflict if China were to

resort to force. India's military weakness was not limited to the strategic decision-making process. It also showed up in the inability of individual services, and the joint response of the armed forces against Chinese aggression. Purohit observes:

> There was no planning done jointly between the two Services prior to or during the conflict for contingencies and targeting. Neither Service thought it worthwhile to war-game or brainstorm even when war clouds were looming. Both, ground and air operations lacked a structured and synergistic application. The primary reason for lack of jointmanship in the conflict is hence attributable to a leadership failure at the strategic level (both political and military). The abysmal state of CMR prior to the conflict only aggravated the situation.[11]

This situation did not improve during the 1965 Indo-Pak War, with joint planning and conduct remaining well below desired levels. Air Chief Marshal P. C. Lal, the then Chief of Air Staff, was scathing in his criticism of the senior leadership of the Indian Army. He accused the army's senior leadership of considering military operations primarily their affair, with the other services on the fringe. He also rued the inability of the service chiefs to be a part of a joint planning process, which adversely impacted the military operations. This was despite the Chiefs of Staff Committee (COSC) being in place, and understanding the requirements of joint planning. According to Lal, joint planning needed contingency planning and preparatory work to set the plans in action—something that had not been done adequately.[12]

The narrative also reinforces the inability of the political leadership to enforce the kind of joint planning and conduct of operations that was desirable under the circumstances. By this stage, the experience of the 1947–48 operations and the 1962 war should have been an adequate learning process, based on the practical application of force against an external adversary. However, until then, this does not seem to have been the case. To that extent, it reinforces the argument by Anit Mukherjee on the adverse impact of civil-military relations as a factor in jointness. 'Without civilian intervention, we would expect to find the three services settling upon the 'coordination model' which maximizes their autonomy.'[13] Yet, it was by no means the only, or the most important, constraint on achieving jointness as subsequent operations indicate.

In contrast to the preceding wars, the 1971 Indo-Pak campaign is widely regarded as one of the better examples of jointness on display during the war. This was despite the fact that coordinating military structures did not change until then. The COSC was still in place with the three service chiefs of the day.

However, unlike the previous wars, the planning process began with a clear politico-military aim. The armed forces were given adequate time for planning and preparation. There was far better coordination among them. This was evident not only at the level of the service chiefs but also in subordinate commanders. The helicopter landing across the Meghana River that dropped a brigade-sized force became a turning point in the war. The airdrop at Tangail was an equally striking operation. It was a classic case of jointness between the Army and Air Force that continues to be cited by both services as an ideal example of forging battlefield cohesion in the face of the enemy.[14]

During the Kargil Conflict in 1999, there is evidence of two distinct phases of India's military response. The first was from the detection of the intrusion on 03 May till 24 May, wherein a degree of disunity in planning and execution of plans was evident. From 25 May, a clearer, focused, cohesive, and comprehensive response came into play. This witnessed the first air strikes on 26 May 1999, and the victory at Tololing during the second week of June, leading to the declaration of final victory on 26 July 1999.[15]

During both these phases, military structures, however imperfect, remained the same. The level of political interest and involvement was also consistent. However, the quality of the joint response after the Chiefs of Staff Committee Meeting on 23 May 1999, and the Cabinet Committee on Security Meeting on 24 May 1999, improved appreciably.[16] It led to a joint military response, with the three services undertaking joint planning and the joint execution of operations. There was a joint follow-up daily to further fine-tune the military response. In addition, the diplomatic actions were tailored to reflect the military realities and objectives seamlessly.

This was reflected in the engagement with Sartaj Aziz in New Delhi. At this time, the military situation was precarious. Aziz was stunned by the recorded conversation between Army Chief General Musharraf, and his Chief of General Staff Lt Gen Mohammad Aziz, on the eve of talks on 11 June.[17] This also coincided with the early indicators of victory the next day, when Tololing was on the verge of being captured, strengthening India's military position appreciably.[18]

A similar joint strategy was adopted when Nawaz Sharif landed in the USA in a desperate attempt to meet President Clinton. The meeting was scheduled for 04 July 1999. India's strategic posture was yet again held in balance with the attack on Tiger Hill underway. The success of the initial phase of the operation yet again facilitated a hardline by Prime Minister Vajpayee when Clinton got in

touch with him during the talks. The unrelenting Indian position, military successes, and US support for the country's responsible approach left little option for Pakistan but to retreat in the face of acute embarrassment, without as much as a face-saver.[19]

A sharper focus on the decision-making processes during the conflict helps derive important lessons for analysing the challenge of jointness. Commencing with the CCS meeting on 24 May 1999, wherein a degree of clarity had been achieved on the nature of the threat, the ensuing processes began to witness greater cohesiveness. The politico-military decisions involved the three service chiefs, and the National Security Advisor (NSA), Brajesh Mishra. The CCS met daily to take stock of the war effort. These meetings also included senior representatives from the ministries involved in the planning process, and special invitees as and when the need arose. General Malik notes,

> Complete synergy and consensus could be discerned among the various organs of the government—whether it was political control or military actions—from political direction to execution in the field and to proactive diplomacy. It was a refreshing change in the decision-making process, both at the political level as well as at the Armed Forces level; open and direct…All these developments led to a very integrated approach to 'war management', with the political, economic, diplomatic, media and military agencies meshed together cogently.[20]

Evidently, it was feasible to streamline wartime processes with the direct intervention of the political leadership, despite the inadequacy of existing structures. However, could this involvement offset the gaps in capability development that existed in the armed forces in 1999?

General Malik notes that the service chiefs gave their list of military requirements to the NSA to procure emergency requirements over the next two to three months. However, he notes 'except for a few items, we did not get much during the war.'[21] This was not a complaint. Rather, a statement of fact reflecting the reality of the procurement process even during the war, which has implications for the national military capability development process.

Similar lessons emerged from efforts at jointness between the services. Analysing Operation Safed Sagar—the IAF's air operations—Malik reinforces the need for 'improved tactical and strategic intelligence and the need for closer, real-time liaison between the Army and Air Force at all levels.'[22] It indicates that jointness achieved during peacetime training and structural integration cannot be substituted by even the most earnest efforts at achieving cohesiveness during a

war. It further suggests that processes and procedures perfected during years of preparatory work create the foundations for military effectiveness and excellence in war. These might be most visible in warfighting; however, they are equally relevant for ensuring operational logistics, especially when operating on a service-specific rather than integrated logistics model.

These actions were not limited to jointness on the military front, but extended onto the wider strategic sphere where diplomacy, strategic communications and the entire national security architecture came into play.[23] This suggests that while jointness remains a critical attribute for enhancing the armed forces' effectiveness, it must not be limited to the services for any meaningful impact at the national level.

Key Conclusions

Some of the key conclusions that can be drawn from the examples quoted above are

- The element of a joint vision is an important starting point for the wider jointness process. At each subsequent stage, jointness of effort remains important. This includes joint training, planning, operations, and follow-up to eliminate previous limitations noted during an iterative process.
- These actions are supported by joint capability development, and logistics support effort. The Kargil conflict is instructive in this regard. After initial setbacks and the mistake of taking a service-centric approach, joint planning, operations, and follow-up proved successful. However, it could not overcome the constraints imposed by the limitations of joint training, capability development, structures, and logistics support mechanisms.
- Political involvement in national security decision-making is an important aspect of jointness. When a joint vision accompanies this involvement, it facilitates strategic decision-making. This was evident during the 1971 Indo-Pak War as well as the Kargil conflict. More recently, the government's decision to appoint the Chief of Defence Staff and the Department of Military Affairs in 2019, are examples of positive interventions that facilitate jointness.[24]
- It is evident from the previous case studies that, despite having the same higher defence management structure, the scale and scope of jointness varied during different wars. In this sense, creating a structure is not the only answer to ensuring jointness. Structures are facilitating elements to better implement processes and procedures, yet are not ends in themselves.

- The past wars suggest that even before the concept of an 'all-of-government approach' became popular, wars and security challenges were always characterised by it. Diplomacy, strategic communication, civil defence, communication networks, data networks, and telecommunications, to name a few, contribute to the national effort. To that extent, while jointness within the armed forces and defence establishment is important, it cannot and must not end there. Jointness must encompass the wider national effort within its scope of a cohesive response.
- Civil-military relations and jointness within the security establishment must be characterised by an equilibrium unique to each country. Unless such a state is achieved, its adverse impact will be felt, especially during wars.
- Jointness is a continuous process. The mere process of creating an integrated command or other structures does not suggest the finalisation of the process. This can be seen from the US experience over the decades in an attempt to achieve excellence.
- Jointness during war under pressure and duress is not enough as a long-term solution for enhancing jointness. The examples of the Kargil Conflict and the Ukraine War are suggestive of this reality.
- Individuals will always matter positively and negatively. Ideally, jointness limits the adverse impact of their influence on nations fighting a cohesive campaign.

The examples quoted above help draw certain conclusions regarding jointness during wars. However, as highlighted earlier, conflict situations force a degree of cohesion in the face of adverse conditions. It can be argued that wars tend to reflect crisis management rather than a structured approach to achieving jointness. This is true to an extent. Wars and warlike situations lead to regular interaction with the political leadership, and among national security stakeholders. It may partially explain jointness when viewed through the prism of wars though; it does not necessarily reflect a comprehensive foundation through this endeavour.

Complex and intangible aspects like jointness may be difficult to quantify, but they can be evaluated through the presence of appropriate structures, processes, and procedures. The impact of their absence cannot be suddenly harmonised before adverse situations, or entirely offset during crises. This becomes most apparent in the development of an inter-services culture, which takes decades to evolve, and cannot be hastened. To that extent, the inference drawn from wars is merely a test case in the absence of other objective means to judge the qualitative

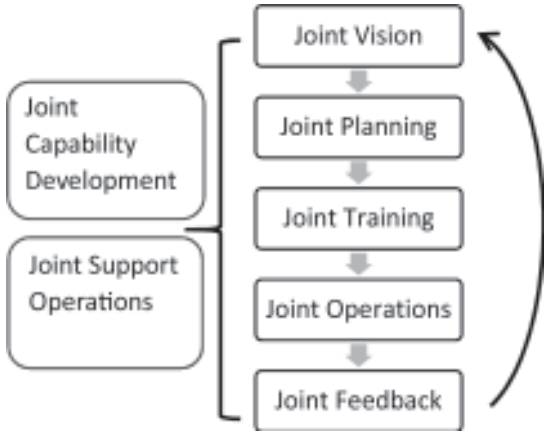
aspects of jointness. Further, one finds varying evidence over time, despite similar structures and procedures. This could be the influence of personalities involved as seen during the 1965 and 1971 wars. Similarly, the circumstances leading to a war can also impact levels of jointness, wherein longer periods allow shortcomings to be ironed out in contrast to an unexpected enemy offensive.

Model for Evaluating Jointness

Given the limitations of employing wars as the sole criteria for evaluating jointness which, despite being a useful indicator of jointness, cannot serve as a comprehensive reflection on integrated structures, existing processes, and procedures. Can these constraints be minimised to limit the impact of personalities and the absence of appropriate structures, processes, and procedures? This essay suggests certain options to enhance jointness in the armed forces.

It considers four key attributes for facilitating jointness: joint elements, joint structures, joint processes, and joint procedures. Joint elements refer to the constituents of a cohesive process that commences with a vision, and is completed with feedback in a closed loop. It also includes joint planning, joint training, joint operations, joint capability development, and joint support. If these elements are placed in a schematic diagram, then these elements can be placed in the sequence shown in Figure 6.1.

Figure 6.1: Key Elements for Jointness



The above layout indicates that the building blocks of jointness commence with a vision. This can be integrated at several levels. Within the government, it

brings all the government's organs dealing with national security to the same level. Increasingly, this also needs to get the participation of the private sector to facilitate their role in the planning and implementation of a comprehensive approach to national security. This should, and often tends to, find expression through a national security strategy. However, in the absence of such a text, internal guidance and policy prescriptions can exist for creating a cohesive response mechanism. The joint vision gives direction for the creation of thematic guidance. This develops in the form of a defence doctrine or guidance in respect of the armed forces, thereby becoming the basis for a joint planning process. The joint planning process emerges as a critical element as it provides the parameters for a long and short-term integrated capability development plan, and joint training guidance for envisaged threats and challenges.

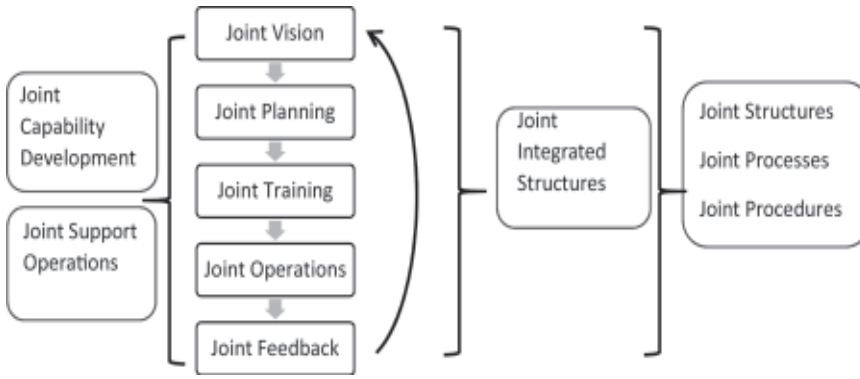
The relevance of joint training becomes evident during the conduct of joint operations wherein the armed forces bring the strength of their battlefield cohesion achieved through sustained training for multiple contingencies into effect. It is equally relevant to draw the requisite lessons from the operations to provide objective feedback for improving upon the effectiveness of joint operations. The failure of Operation Eagle Claw was one of the driving factors for defence reforms in the USA. Similarly, the lessons learned during the Kargil Conflict were documented by the Kargil Review Committee and Group of Ministers Report, leading to far-reaching defence reforms in India.[25]

Two elements demand sustained effort over sustained periods. This includes capacity building and support operations. The planning for procurement emerges from the national security vision, and follows a long-term capacity-building roadmap. The challenges associated with research, development, and the manufacture of futuristic technologies demand a joint, cohesive, and clearsighted planning process to achieve optimum capability within the desirable time frame. Given the involvement of R&D entities, the private sector, the public sector, and the armed forces in this process, the formulation of a joint vision and roadmap is imperative for achieving success. This includes the vital aspect of self-reliance in defence research, development, and manufacture.

The second aspect deals with a sustained process of supporting the armed forces under routine peacetime and operational conditions. The Kargil conflict and, more recently, the challenge emerging after the 2020 face-off against China, has reinforced the importance of a joint planning process that allows the buildup of resources in the desired time frame.

These elements are supported by three aspects that ensure the success of each of these endeavours. The first is the importance of integrated structures. Second, is the necessity of joint processes, and third, the need for joint procedures as indicated at Figure 6.2. There has been a longstanding debate around the relevance of integrated structures in the overall intention to achieve jointness. It can be argued that the physical integration of structures is not a necessity, and the existence of joint planning and training is enough to achieve jointness in operations. Conversely, while it is possible to enhance jointness in the absence of physically integrated structures, the presence of such structures does facilitate bringing about jointness, especially if this is accompanied by jointness in processes and procedures. These can further be supported—and made more effective—through the use of enabling mechanisms. This includes a robust communication interface, and decision support models based on the ability to harness data—driven by technology and a human interface.

Figure 6.2: Model for Enhancing Jointness in the Armed Forces



This enabling mechanism is best illustrated through examples that reinforce its importance. It has been mentioned earlier that a joint vision can be communicated, and shared with all stakeholders through a joint doctrine and/or a national security strategy. This can become the basis for a defence strategy as its subset. The defence strategy lays down the envisaged ends, the capabilities that the Ministry of Defence envisages, and the primary, secondary, external, and internal threats. It must also outline the *means* that are available, or likely to be created, over the foreseeable future, and the *ways* in which the means are likely to be employed to enable the achievement of the ends. This allows a more deliberate military planning process through plans and contingencies for the threats

identified. It also caters for probable contingencies—like military and humanitarian assistance.

The aspect of structural integration becomes apparent from the examples discussed. However, co-relating processes and procedures are arguably more relevant to achieve jointness. The dictionary meaning of process is defined as 'a series of actions that you take to achieve a result'.[26] Different processes will require a variety of actions to complete as envisaged. In the military domain, the procurement of weapon systems will need a process for its successful implementation. Similarly, a joint capability-building process will also outline a series of actions to achieve the desired aims. A procedure also envisages a series of steps for its completion. 'Surgical procedure' is a common term, often used to illustrate its usage. In military terms, one of the most common examples is battle procedure. This is defined as simultaneous steps taken at different levels for the successful completion of a task.

When processes and procedures are evaluated from a jointness perspective, then processes will involve a strategic orientation, while procedures tend to be more task-oriented. A process may, therefore, include several procedures that facilitate its completion. Accordingly, when the human resource management process in the three services is streamlined for greater compatibility, several procedures are involved, including endorsing the annual confidential reports which will need harmonisation. Similarly, the procedure for the induction of recruits has been harmonised with the introduction of the Agniveer scheme, and the Inter-Services Organisations (Command, Control and Discipline) Act facilitated the delivery of justice by commanders of the integrated organisations of the armed forces.[27]

These illustrations suggest that any endeavour aimed at enhancing jointness in the armed forces, and beyond that of the security establishment will involve the identification of processes and procedures that need not only bring about greater cohesion of functioning but facilitate a shift in the organisational culture from a single service to a joint service character. It might be difficult to tangibly evaluate the degree of jointness in an organisation while integration in structural terms can be identified with greater ease. Yet, evaluating the effectiveness of elements and their associated integrated structures, processes, and procedures can assist in the planning and implementing of such an endeavour. To that extent, the Jackson model duly modified to suit the requirements of different organisations, along with additional elements for evaluation, can serve as a useful tool for assessing jointness in the armed forces and, to an extent, at levels beyond that as well.

Conclusion

There is little difference between services, government agencies, and think tanks regarding the need for jointness. Yet, the lack of clarity on the meaning of complementary terms, like jointness and integration, can potentially diffuse the sharp focus needed to pursue comprehensive jointness in all its manifestations. An attempt has been made to provide greater clarity, to include the Joint Doctrine issued by the Headquarters Integrated Defence Staff in 2017. However, this has proved inadequate, given the lack of clarity between the terms from a practical perspective and its ensuing implementation.

If the history of jointness is any indicator of its implementation, then there is adequate evidence to suggest that the creation of structures alone is not enough to ensure success. While this is a desired contributing factor, it is not an end in itself, and must be accompanied by requisite processes and procedures to ensure that integrated structures operate optimally.

Harmonising the functioning of different services, agencies, and departments is an important pre-requisite for creating jointness. However, this should not become an endeavour to eliminate service-specific characteristics and unique strengths. True harmonising ensures that the sum of the whole represents more than each individual part.

Unlike creating an integrated structure, achieving jointness is a continuous exercise that must remain an abiding endeavour. While facilitating attempts should be made to introduce supplementary processes, jointness will ultimately get tested during a crisis. It will be most evident during conflicts and wars, when a joint vision—harnessed through years of joint training—is implemented through a joint planning process in combat. The strengths and weaknesses of this endeavour were evident during the Kargil conflict. Similarly, this will potentially get tested every time the country faces a challenge. It needs little reinforcement that capabilities built over time cannot be created over a few months, irrespective of the domestic and international support available to support such endeavours. This will be reflected in a long-term joint capability development exercise, as part of a larger national endeavour.

NOTES

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7

Size vs. Technology in Modern Armies: A Dance for Agility

Rajeev Sabherwal

'*In modern warfare, the balance between manpower and technology is crucial. Neither can fully compensate for the lack of the other*.'

—General David Petraeus

Introduction

The contours of warfare have undergone a profound transformation in recent decades, affecting all militaries across the globe. The advent of technological advancements, the increasing complexity of the operational environment, and the evolving nature of threats have rendered traditional models of military force obsolete. In this era of rapid change, organizational agility has emerged as a critical determinant of military success. Armed forces must possess the capacity to adapt swiftly to new challenges, innovate rapidly, and operate effectively in ambiguous and uncertain conditions. This convergence of factors necessitates a critical re-evaluation of India's force structure.

Central to the debate on optimizing military force structure is the perennial question of size versus technology. Proponents of large, conventional forces argue for mass, manpower, and endurance as the bedrock of national security. Conversely, advocates of a technology-intensive military emphasize precision, advanced surveillance, and information superiority, arguing that these factors are more aligned with the demands of modern warfare. The optimal balance between these

two approaches is a complex issue, with far reaching implications for India's defence posture.

This essay aims to explore this complex issue through the lens of the Indian military. Through a detailed analysis of the strengths and weaknesses inherent in both size and technology-centric approaches, this study seeks to contribute to the ongoing discourse on force structuring. By examining these factors, the essay will provide insights into the future direction of India's armed forces, offering recommendations for achieving an optimal balance that meets the unique strategic needs of the nation.

The Evolving Nature of Warfare: Challenges for the Indian Armed Forces

The contemporary security landscape is undergoing a rapid transformation, marked by the convergence of technology, geopolitics, and societal changes. This evolution has profound implications for the nature of warfare, posing new challenges for the Indian Armed Forces.[1] Before we delve into the implications of the evolving nature of warfare confronting the Indian Armed Forces it would be prudent to highlight the key characteristics of modern warfare instrumental for this change.

Key Characteristics of Modern Warfare

- *Hybrid Warfare.* Hybrid warfare is a complex blend of conventional and unconventional warfare tactics, designed to achieve strategic objectives without resorting to overt military aggression. It leverages information, cyber, and economic tools alongside military force.[2] India has faced hybrid warfare tactics from Pakistan, particularly through cross-border terrorism, proxy warfare, and information warfare to influence public opinion in Kashmir. China's aggressive posturing along the Line of Actual Control (LAC) also incorporates elements of hybrid warfare, with economic coercion and information operations complementing military pressure.[3]
- *Information Warfare.* Information warfare involves the weaponization of information to manipulate public opinion, disrupt critical infrastructure, and degrade decision-making. Cyberattacks are a key component of this, targeting command and control systems. The annexation of Crimea and the conflict in Eastern Ukraine serve as a comprehensive example of how information warfare can be effectively integrated into modern military strategy. By leveraging media, cyber capabilities, psychological operations,

and diplomatic measures, Russia was able to achieve significant strategic objectives with limited conventional military engagement. This case underscores the growing importance of information dominance in contemporary conflicts.

- *Precision Strike.* Precision strike capabilities emphasize long-range, precision-guided munitions to minimize collateral damage while maximizing military effectiveness. This hinges on seamless integration with intelligence, surveillance, and reconnaissance (ISR) capabilities. The surgical strikes conducted in Pakistan-occupied Kashmir in 2016 demonstrated the Indian military's ability to execute precise strikes.[4]
- *Autonomous Systems.* Unmanned aerial, ground, and maritime vehicles are increasingly deployed, with artificial intelligence enhancing decision-making and autonomy. However, ethical considerations and international law implications are complex. The Bayraktar TB2 and MQ-9 Reaper exemplify the transformative impact of autonomous systems in modern warfare. Their ability to operate autonomously, provide real-time ISR, and conduct precision strikes has reshaped military tactics and strategy. These drones have demonstrated how autonomous systems can enhance situational awareness, reduce risks to human operators, and deliver precise and effective combat capabilities.
- *Space as a Warfighting Domain.* Space is recognized as a critical domain for military operations. Anti-satellite capabilities and space-based weapons pose potential threats, while space-based ISR and communications are essential for military operations. The increasing militarization of space, and the development of ASAT weapons by major powers, including India, highlight space as a critical war-fighting domain in modern warfare. The establishment of dedicated military space forces, the deployment of advanced surveillance and reconnaissance satellites, and the testing of ASAT capabilities demonstrate the strategic importance of space in maintaining national security and military superiority.
- *Non-State Actors.* Terrorist organizations, insurgencies, and other non-state actors pose complex challenges. Global networks and cross-border operations complicate counter-insurgency and counter-terrorism efforts. India faces threats from various non-state actors, including cross-border terrorism from Pakistan, and insurgency in regions like Kashmir and the North East. The complex nature of these threats requires a comprehensive approach involving the military, intelligence, and diplomatic efforts.

The evolving nature of warfare, with its dynamic characteristics, presents significant challenges and transformational implications for the Indian Armed Forces. Adapting to these challenges requires a multifaceted approach, including technological advancements, doctrinal changes, and enhanced cooperation with other security agencies.

Implications for the Indian Armed Forces

- *Agility.* The Indian Armed Forces must develop the ability and capacity to adapt to rapidly changing operational environments and employ a wide range of capabilities efficiently.
- *Technological Integration.* Prioritising investments in advanced technologies, such as artificial intelligence, cyber warfare, and space-based systems, is crucial.
- *Jointness.* Enhanced inter-service cooperation and coordination are essential for effective operations in the multi-domain modern battlefield. A unified approach will ensure the seamless execution of complex missions and optimize the use of available resources.
- *Human Capital Development.* Focus on training and education is key to equipping personnel with the competencies and perspectives needed for tomorrow's challenges.
- *Intelligence, Surveillance, and Reconnaissance (ISR) Capabilities***.** Enhanced ISR capabilities are critical for achieving information superiority in modern conflicts. The Indian Armed Forces must invest in advanced ISR platforms, including drones, satellites, and cyber intelligence tools, to ensure real-time situational awareness.
- *Civil-Military Synergy.* Building strong relationships with civil institutions and the government is essential for public support and effective governance.
- *Multi-Domain Integration.* Modern warfare is increasingly fought across multiple domains—land, sea, air, space, and cyberspace. The Indian Armed Forces must develop the capability to conduct integrated operations across these domains seamlessly.

India's Strategic Dilemma: Size vs. Technology

As the nature of modern warfare rapidly evolves, driven by technological advancements, shifting geopolitical dynamics, and emerging security challenges, the Indian Armed Forces are at a critical juncture. The traditional dichotomy between manpower-intensive and technology-centric military forces is increasingly

becoming obsolete. In its place, the imperative for organizational agility has emerged as a critical determinant of military effectiveness. The evolving nature of modern warfare necessitates agile militaries that can adapt to ever-changing threats and challenges. Traditional concepts of large, manpower-intensive armed forces are being challenged by the rise of technology-intensive capabilities. For India, this evolution presents both opportunities and challenges. As a nation with a significant strategic footprint and diverse security threats, India must navigate the delicate balance between maintaining a sizeable military force and integrating advanced technologies to enhance operational effectiveness. To gain a deeper understanding of this strategic dilemma, it is essential to delve into historical perspectives and examine how the interplay between size and technology has shaped military capabilities throughout history.

Historical Context

The historical context of Indian military strategies shows a dynamic interplay between the size of the armed forces and technological advancements. While large armies provided raw power and psychological leverage, technological advancements have often determined the outcomes of critical battles. The ideal composition, therefore, has varied with time, dependent on the specific military, political, and geographical challenges faced. Let us examine a few specific examples.

Ancient India: The Mauryan Empire

The Mauryan Empire (322–185 BCE) under Chandragupta Maurya and Ashoka the Great is an excellent example of leveraging both size and technology. The Mauryan Empire maintained one of the largest armies of its time, with accounts suggesting a standing army of 600,000 infantry, 30,000 cavalry, and 9,000 war elephants.[5] This massive force helped Chandragupta Maurya to establish and consolidate one of the largest empires in Indian history by sheer numbers and overwhelming force. On the other hand, the use of war elephants in battle was a significant technological advancement that provided a psychological edge and a physical advantage over enemies. Ashoka's military campaigns, supported by these war elephants, helped expand the empire significantly before his turn to Buddhism and non-violence.

Medieval India: The Delhi Sultanate and the Mughal Empire

The Delhi Sultanate (1206–1526) and the Mughal Empire (1526–1857) illustrate shifts in military composition. The Delhi Sultanate relied heavily on large armies

to maintain control over its territories. However, despite large numbers, the Sultanate often faced challenges in governance and control due to logistical difficulties and lack of advanced military technologies. The Mughals, especially under Akbar, incorporated advanced artillery and firearms into their military strategies. Babur's use of gunpowder technology in the First Battle of Panipat in 1526 against Ibrahim Lodi's larger but less technologically advanced army demonstrates the effectiveness of technology. This pivotal battle established Mughal rule in India.

Colonial India: The British East India Company

The East India Company's military campaigns in India highlight the technological versus numerical strength debate. The British forces, though often outnumbered, used superior military technology, including advanced firearms and artillery, and disciplined military tactics. In battles like Plassey (1757) and Buxar (1764), the British were able to defeat much larger Indian forces primarily through technological superiority and strategic alliances. However, the First War of Independence (Sepoy Mutiny) of 1857 showcased the limitations of technology when faced with widespread insurrection. Despite superior weaponry, the British had to rely on reinforcing their numbers with troops from Britain and employing Indian loyalists to regain control.

Post-Independence India

In modern times, the Indian Armed Forces continue to balance size and technology. India's development of nuclear weapons, missile technology, and modern fighter jets represents a significant shift towards a technologically intensive military. The successful use of these technologies, such as in the Kargil War of 1999, demonstrates the strategic advantages of technological superiority. On the other hand, India maintains one of the largest standing armies in the world, which is crucial for its strategic position and diverse security challenges. The size of the army allows India to manage and respond to multiple regional threats simultaneously.

Global Historical Perspective

A glance historically elsewhere in the world also reveals that the size of an army was often equated with its strength. Large armies, such as those fielded by the Roman Empire or the Soviet Union during World War II, relied on sheer numbers to overwhelm adversaries. However, technological advancements have periodically

shifted this paradigm. The advent of gunpowder, mechanized warfare and, more recently, digital technology and unmanned systems, has allowed smaller forces to achieve significant tactical advantages.

The evolution of military strategy shows that both manpower and technology have been crucial in determining the outcomes of conflicts, with the ideal force structure adapting to the specific challenges of each era. A balanced approach that combines numerical strength with technological superiority, while maintaining organizational agility, is essential for sustained military effectiveness. For India, this means leveraging its large standing army while integrating advanced technologies to meet the complex demands of 21st-century warfare. This historical insight, therefore, must be further refined and deliberated, especially considering the factors influencing the balancing act to ensure that India's military remains prepared for future challenges.

The Future of India's Military: Balancing Tradition and Technology

As the historical perspective has clearly revealed, the Indian Armed Forces have been perpetually caught in a complex balancing act, navigating the pressures of a vast geographical expanse, constant internal and external threats, and the rapidly evolving nature of warfare. This delicate equilibrium is influenced by several factors.

Manpower vs. Modernization

- *Manpower Intensity.* India's vast borders and the potential for multi-front conflicts necessitate a large standing army. This manpower-intensive approach provides a significant advantage in terms of territorial control and rapid mobilization.
- *The Modernization Imperative.* The increasing complexity of modern warfare demands advanced technology, precision weaponry, and efficient command and control systems. This requires substantial investments in research and development, procurement, and training.
- *Trade Off.* Balancing the demands of a large force with the need for modernization presents a significant challenge for a developing nation like India. Limited defence budgets often necessitate trade-offs between manpower and technology. The regular force restructuring exercises undertaken by the Indian Armed Forces demonstrates their efforts to meet such challenges.

Conventional vs. Asymmetric Threats

- *Conventional Challenges.* India faces potential conventional threats from neighbouring countries, necessitating a robust conventional force. This includes maintaining a strong army, navy, and air force capable of defending territorial integrity.
- *Asymmetric Threats*. The rise of terrorism, insurgency, and hybrid warfare poses unique challenges. These require specialized forces, intelligence capabilities, and counter-terrorism adeptness.
- *Balancing Act.* The Indian Armed Forces must effectively allocate resources to address both conventional and asymmetric threats. This involves developing a comprehensive approach that incorporates counter-insurgency, counter-terrorism, and conventional warfare capabilities.

Jointness vs. Service-Specific Priorities

- *Service-Specific Focus.* Each Service (Army, Navy, Air Force) has its own unique priorities and cultures. This can sometimes hinder inter-service cooperation and joint operations.
- *Need for Jointness.* Modern warfare demands seamless integration of all Services in all domains of warfare. Joint operations, command and control structures, and doctrine are essential for effective responses to complex threats.
- *Balancing Act.* Striking the right balance between Service-specific requirements and the need for jointness is crucial for operational success.

Indigenization vs. Global Partnerships

- *Self-Reliance.* India aims to reduce dependence on foreign defence equipment through indigenization efforts. This includes promoting domestic research and development, manufacturing, and technology acquisition.
- *Global Partnerships.* Collaborations with foreign defence industries and governments can provide access to advanced technology and expertise.
- *Balancing Act.* India needs to carefully balance self-reliance with the benefits of global partnerships to build a robust and resilient defence ecosystem.

Budgetary Constraints and Resource Allocation

- *Limited Defence Budget.* India's defence budget, while increasing, faces constraints compared to global military powers.

- *Prioritization.* Effective allocation of resources requires careful prioritization of defence needs based on threat assessments.
- *Balancing Act.* Finding the optimal balance between different defence requirements, such as modernization, wage bill and pension costs, and infrastructure development, is challenging.

Addressing these challenges requires a comprehensive and long-term approach. This brings us to the major question: should the Indian Armed Forces go in for a large, manpower intensive model? Or, a technology driven model? Or, one which balances both, based on the factors discussed? It would be prudent to analyse each one of them in greater detail before finalising on the model which would be most beneficial for the Indian Armed Forces.

Arguments for a Large, Manpower-Intensive Indian Armed Forces

India's decision to maintain a large, manpower-intensive armed force is rooted in several strategic and geopolitical considerations:

Territorial Control and Border Management

- *Vast Borders.* India has a land frontier of 15,200 km and a coastline of 7,516.6 km, sharing extensive borders with several countries, including China and Pakistan, both of which possess significant military capabilities.[6] A large standing army is essential to effectively patrol and secure these borders.
- *Internal Security.* India has faced various internal security challenges, including insurgencies and terrorism. A sizable force is required to maintain law and order and counter these threats.

Rapid Mobilization and Deployment

- *Geopolitical Tensions.* The volatile geopolitical situation in South Asia necessitates a force capable of rapid mobilization in case of aggression or conflict. A large standing army can be quickly deployed to reinforce forward positions or counter potential threats.
- *Natural Disasters.* India is prone to natural disasters such as floods, earthquakes, and cyclones. A large military force can be effectively utilized for disaster relief and humanitarian assistance operations.

Human Factor and Adaptability

- *Complex Terrain.* India's diverse geographical features, including high altitude mountains, glaciers, deserts, jungles, and coastal areas, require troops with specific skills and knowledge. A large force ensures a wider pool of personnel, with varied expertise.
- *Cultural Understanding.* In regions with complex ethnic and religious demographics, like Kashmir, Ladakh and the North East, troops with local language and cultural understanding can effectively connect with the population, and build trust.
- *Agility.* A large force provides greater flexibility in adapting to changing operational environments and emerging threats.

Psychological Deterrence

- *Power Projection.* A large, well-equipped military force serves as a deterrent to potential adversaries. The sheer size and capability of the armed forces can discourage aggression and maintain regional stability.
- *National Pride.* A strong military is often seen as a symbol of national pride and unity.

While the benefits of a large, human-centred military force are undeniable, the changing face of warfare demands significant investment in technology and modernization. To ensure the Indian Armed Forces remain competitive, and capable of meeting the challenges of the 21st century, a compelling case can be made for prioritizing the transition to a more technology-intensive force.

A Tech-Intensive Indian Armed Forces

The increasing complexity and dynamism of modern warfare necessitate a shift for the Indian Armed Forces towards becoming a tech-intensive force. This paradigm shift is driven by several factors.

Precision and Effectiveness

- *Reduced Collateral Damage.* Advanced weaponry systems, such as precision-guided munitions, allow for more targeted strikes, minimizing civilian casualties. The Indian Air Force's use of precision-guided munitions (PGMs) during the Balakot airstrike in 2019 exemplifies the importance of technology in reducing collateral damage.[7]
- *Enhanced Accuracy.* Technological advancements improve the accuracy of

targeting systems, increasing the effectiveness of military operations. The Indian Air Force's recent acquisition of the Rafale fighter jets, equipped with advanced targeting systems and sensors, is a testament to this trend.

- *Operational Efficiency.* Technology can optimize resource allocation, streamline logistics, and improve decision-making processes. The Indian Navy's integration of Network-Centric Warfare (NCW) capabilities, such as the Information Management and Analysis Centre (IMAC), has streamlined decision-making and resource allocation during maritime operations.[8]

Cost-Efficiency

- *Smaller Force.* A tech-intensive force can often be smaller in size while maintaining, or even enhancing, combat capabilities. India's development of long-range, accurate ballistic missiles, like the Agni-V, allows strategic deterrence without the need for a large missile force.[9]
- *Reduced Personnel Costs.* Fewer personnel can lead to lower expenditure on salaries, training, and logistics. Modern technologies, like AI and robotics, can be leveraged effectively to undertake tasks which are dull, dangerous, or dirty to reduce critical manpower.
- *Technological Leverage.* Investments in technology can yield significant returns in terms of operational efficiency and effectiveness. India's investment in the development of the BrahMos missile has provided the armed forces both an operational advantage as well as a strategic edge.

Agility and Adaptability

- *Rapid Response.* Advanced communication and surveillance systems enable quicker decision-making, and faster response times to emerging threats. The Indian Navy's acquisition of advanced maritime surveillance aircraft, like the P-8I , has significantly enhanced its capabilities in the maritime domain.[10] This was demonstrated in 2017 when the Navy foiled a Somali pirate attack in the Gulf of Aden using the *INS Sharda.*[11] More recently, in November 2023, the *INS Sumedha* played a crucial role in rescuing a vessel from a Houthi rebel attack in the Red Sea, showcasing the Navy's rapid response capabilities.[12]
- *Flexibility.* Tech-intensive forces can be more easily reconfigured and deployed to suit changing operational requirements. Special Forces in India and across the globe are known for their adaptability, and ability to deploy

rapidly to various environments, often supported by advanced technology.

- *Information Superiority.* Access to real-time data and intelligence provides a decisive advantage on the battlefield. The Indian Armed Forces' investment in satellite technology, like the GSAT-7 series, ensures real-time data and communication capabilities, providing a decisive advantage on the battlefield. and underlines the importance of information superiority in modern warfare.

Deterrence and Power Projection

- *Technological Edge*. The possession of advanced weaponry and technology, like the Agni-V intercontinental ballistic missile (ICBM), and the nuclear-powered submarine *INS Arighaat*, can deter potential adversaries, and enhance India's global standing.[13]
- *Force Multiplier*. Technologies like EW, Cyber, Robotics, AI, etc, can amplify the capabilities of existing forces, making them more potent and effective. Internationally, Israel's Iron Dome system, which relies heavily on advanced radar and missile technologies, showcases how technology can serve as a force multiplier.

Future-Proofing the Military

- *Technological Advancements.* Investing in emerging technologies ensures that the armed forces remain at the forefront of military innovation. This approach is reflected in China's heavy investment in AI and other disruptive technologies, positioning itself as a future military superpower.
- *Operational Advantage.* Embracing new technologies can create a significant operational advantage over adversaries. The Indian Army's induction of smart surveillance and reconnaissance systems along the borders provides a significant operational advantage over adversaries. This is in line with global practices, such as the USA's DARPA programs, which continually push the boundaries of military technology to maintain an operational edge.

While a tech-intensive force offers numerous benefits, it is essential to recognize that it is not a complete replacement for manpower. While technology offers significant advantages, human expertise remains indispensable for effective operations. By carefully integrating both elements, the Indian Armed Forces can enhance their capabilities and address the complex challenges of the modern security environment.

Ultimately, achieving a balanced force is an ongoing process that necessitates continuous evaluation, adaptation, and a steadfast commitment to leveraging both manpower and technology to their full potential. By proactively addressing challenges and capitalizing on opportunities, the Indian Armed Forces can position themselves for success in an increasingly complex and dynamic security environment.

To adroitly navigate this intricate equilibrium, studying the strategies of global powerhouses like the USA, China, and Israel becomes imperative. These nations have invested significantly in researching and implementing optimal blends of manpower and technology. The USA, for instance, has excelled in technological dominance while maintaining a robust military personnel base. China, on the other hand, has rapidly modernized its armed forces with a focus on technological advancements, coupled with a massive manpower pool. Israel, renowned for its innovation, has successfully integrated cutting-edge technology into a relatively small military force. By analysing these case studies, India can glean valuable insights into effective strategies for optimizing its own force structure.

Case Studies: Global Models of Balancing Manpower and Technology

The USA

The USA has adopted a strategy of leveraging technological superiority to maintain a smaller, more agile force. This approach is underpinned by several key factors.

- *Technological Dominance.* The USA has consistently invested heavily in research and development, leading to breakthroughs in areas such as aerospace, electronics, and computer science. This has translated into a military advantage characterized by advanced weaponry, surveillance systems, and communication technologies.
- *Network-Centric Warfare.* The US military has pioneered the concept of network-centric warfare, emphasizing information sharing, real-time decision-making, and the integration of various military assets. This approach enhances operational efficiency and effectiveness.
- *Precision Strike Capabilities.* A focus on precision strike capabilities has reduced the need for large-scale troop deployments. Advanced missile systems, coupled with accurate intelligence, allow for targeted engagements with minimal collateral damage.

- *Force Projection.* The USA maintains a global military presence through a network of bases and forward-deployed assets. This enables rapid deployment of forces in response to crises.

In essence, the US model prioritizes technology as a force multiplier, enabling a smaller force to achieve disproportionate effects.

China

China's military modernization strategy involves a combination of maintaining a large force and incorporating advanced technologies. This approach is driven by the country's geopolitical ambitions and the desire to challenge US dominance.

- *Mass-Based Strategy*. China maintains a large standing army, reflecting its territorial ambitions and the need for manpower-intensive operations.
- *Technological Convergence.* Simultaneously, China is investing heavily in advanced technologies, including hypersonic missiles, artificial intelligence, and cyber warfare. These capabilities are intended to offset numerical advantages enjoyed by potential adversaries.
- *Indigenization.* A key focus is on developing indigenous military technology to reduce reliance on imports and to protect intellectual property.
- *Military Civil Fusion (MCF) Policy.* China leverages its civilian technological advancements for military applications, accelerating the pace of military modernization.

China's approach seeks to combine the strengths of a large force with the cutting-edge capabilities offered by technology.

Israel

Faced with existential threats and limited resources, Israel has adopted a strategy of technological innovation to compensate for its smaller size.

- *Qualitative Military Edge.* Israel has developed a reputation for military innovation, focusing on areas such as unmanned aerial vehicles (UAVs), missile defence, and cyber warfare.
- *Intelligence-Led Warfare.* The Israeli Defence Forces (IDF) place a strong emphasis on intelligence gathering and analysis, enabling precise targeting and effective operations.
- *Rapid Adaptation*. Israel's history of facing numerous conflicts has fostered a culture of rapid adaptation and innovation.

- *Start-up Ecosystem*. The country's vibrant start-up ecosystem contributes to the development of cutting-edge military technologies.

Israel's model demonstrates how a smaller nation can leverage technology to create a disproportionate military advantage.

Lessons for India

India can draw valuable insights from the global case studies to steer its own defence modernization efforts.

- *Technology as a Force Multiplier.* India should prioritize investments in technology to enhance the capabilities of its armed forces.
- *Balanced Approach.* While technology is crucial, maintaining a sufficient manpower base is essential for territorial security and internal stability.
- *Indigenization.* Developing indigenous defence capabilities is vital for reducing reliance on foreign technology and building self-reliance.
- *Jointness and Integration.* Fostering inter-service cooperation, and integrating technology across the armed forces is essential for effective operations.
- *Focus on Research and Development.* Investing in research and development will be crucial for staying at the forefront of technological advancements.

Analysing these global case studies can offer strategic lessons and practical frameworks for the Indian Armed Forces to emulate and adapt, ensuring India builds a robust and modern armed force, capable of meeting the demands of the 21st century.

Forging Agile Indian Armed Forces: Balancing Manpower and Technology

As the world evolves, so too must its military, ensuring it remains a formidable force. The path to a truly effective, agile, and future-ready Indian Armed Forces lies in harmonizing the strengths of a large manpower-intensive force with the potential of a tech-intensive one. This delicate balance requires a comprehensive approach and actions that address several key areas which are pertinent and applicable in the Indian context.

- *Rightsizing the Force: A Strategic Imperative.* Field Marshal Sam Manekshaw is often attributed as saying that a general should be able to fight a war with half the troops he has. This sentiment underscores the need for a comprehensive evaluation of personnel requirements across all operational domains to ensure that the force structure is lean and efficient. Combat

roles should be prioritized by downsizing non-combat positions. Technology such as AI and unmanned systems should be integrated to enhance operational efficiency, allowing for a reduction in troop numbers without compromising effectiveness. Technology should complement rather than replace human decision-making.

- *Strategic Investments in Technology: A Catalyst for Modernization.* Investing in cutting-edge technologies essential for modern warfare, including artificial intelligence, cyber warfare, unmanned systems, and space-based assets is essential. Domestic capability building should be emphasized through initiatives, like Make in India, to reduce dependence on foreign technologies. Innovation should be accelerated by fostering public-private partnerships, leveraging the expertise of both sectors. The collaboration between the Indian Space Research Organisation (ISRO) and private companies should develop space-based assets is a case in point. Focus should be on disruptive technologies that offer significant operational advantages and ensure a phased adoption plan to integrate these technologies into the forces effectively.
- *Fostering Jointness and Interoperability: A Cornerstone of Modern Warfare.* Break down the traditional silos between the Army, Navy, and Air Force should be broken down by institutionalizing jointness. Regularly conduct joint exercises, particularly theatre-level exercises, to enhance interoperability and coordination among the services. Establish unified command structures, such as theatre commands, to streamline decision-making and optimize the execution of multi-domain operations. Promote the development of integrated doctrine and training programs that emphasize joint operations across all domains, including cyber and space.
- *Human Capital Development: The Foundation of a Modern Force.* The Armed Forces are only as effective as its personnel. Investment should be made in advanced training and education programs to ensure that personnel are equipped with the skills necessary for modern, technology-driven warfare. Leadership development is equally crucial. As Dwight D. Eisenhower once said, 'Leadership is the art of getting someone else to do something you need to be done because they want to do it.'[14] Prioritizing leadership development programmes that cultivate qualities like adaptability, innovation, and ethical decision-making, are crucial for navigating the complexities of 21st-century conflicts. Specialized training courses should be developed for operating new technologies and systems to ensure seamless integration of technology with manpower.

- *Infrastructure Development: The Backbone of Modern Warfare.* The upgradation of communication networks, logistics facilities, and training establishments to support the requirements of modern warfare are essential. Focus should be on enhancing cybersecurity measures to protect critical information infrastructure from potential cyber threats. Strengthening the Defence Cyber Agency to safeguard military networks and integrate cyber defence into the broader operational strategy is also necessary. Developing resilient logistics chains and state-of-the-art training facilities to maintain operational readiness in all domains is necessary.
- *Budgetary Allocation: A Strategic Priority.* The adoption of performance-based budgeting to ensure that resources are allocated efficiently, linking budget allocations to clear performance metrics is necessary. Prioritizing investments in areas that offer the most significant operational impact, such as manpower development, technology acquisition, and infrastructure enhancement is also important. Conducting a thorough cost-benefit analyses to identify areas for potential savings and reinvesting these savings in critical modernization initiatives must also be done. Replacing outdated equipment with cost-effective, multi-role platforms to enhance operational efficiency while staying within budget constraints will be necessary.
- *Diversification and Strategic Partnerships.* Diversifying technology sources by developing partnerships with multiple nations, and private sector entities, to reduce the risk of dependency on a single source needs to be considered. Engaging in strategic partnerships with allied countries for technology sharing, joint exercises, and R&D collaborations should also be done. Encouraging the domestic defence industry to innovate and produce high-quality, technologically advanced systems that can meet the needs of the Armed Forces should also be undertaken. Leveraging these partnerships to gain access to cutting-edge technologies and best practices is essential.
- *Multi-Domain Operations Preparedness.* The development of capabilities and doctrines for multi-domain operations that integrate land, sea, air, cyber, and space domains must also be done. Training personnel in multi-domain strategies and ensuring that joint exercises incorporate scenarios that test and refine these capabilities must also be conducted. Equipping the Armed Forces with the necessary tools and systems to conduct operations seamlessly across multiple domains, ensuring agility and responsiveness in a rapidly evolving battlefield environment is imperative.

It is evident that the Indian Armed Forces, like many militaries worldwide, face

the challenge of balancing manpower and technology. By implementing these recommendations, the Indian Armed Forces can effectively balance manpower with technology, creating a more agile, resilient, and capable force, ready to address the challenges of modern multi-domain warfare.

Conclusion

The intricate dance between manpower and technology in modern militaries is a complex and evolving ballet. Neither size nor technology alone can guarantee victory in the contemporary battlefield. The Indian Armed Forces, with its unique challenges and aspirations, must navigate this delicate equilibrium with strategic acumen. A large, manpower-intensive force offers undeniable advantages in terms of territorial control, rapid mobilization, and human adaptability. However, the increasing sophistication of warfare necessitates a commensurate investment in technology. Precision, efficiency, and agility are the hallmarks of modern combat, and these can only be achieved through technological advancements.

The optimal path forward lies in a synergistic approach that leverages the strengths of both manpower and technology. This requires a holistic strategy, encompassing force optimization, strategic technology investments, fostering jointness, human capital development, infrastructure modernization, and effective budgetary allocation. Challenges such as technological dependency, cost implications, organizational culture, ethical dilemmas, and geopolitical factors cannot be ignored. A proactive approach, involving risk assessment, mitigation strategies, and continuous adaptation, is essential to overcome these hurdles.

The Indian Armed Forces stand at a critical juncture. The decisions made today will shape its capabilities and effectiveness for decades to come. By embracing a balanced and forward-looking approach, India can build a military that is not only formidable but also agile, adaptable, and prepared for the complexities of the 21st century. The journey may be fraught with challenges; but the rewards of a successful transition are immense—a secure nation, a respected military, and a prosperous future. Ultimately, the goal is to create a military that is more than the sum of its parts, a force that seamlessly integrates human ingenuity with technological prowess to achieve its strategic objectives. The balance between manpower and technology is not a static equation but a dynamic process that requires constant recalibration. As the world continues to evolve, so too must the Indian Armed Forces, ensuring its relevance and effectiveness in an increasingly complex and uncertain global landscape.

NOTES

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8

Resourcing Military Capability Development and Effectiveness

Samir Gupta

Introduction

The resources of a country are diverse, and need to be viewed in their entirety to determine how they can be applied to develop comprehensive national power. One of the foremost imperatives is to ensure the nation's security to cater for diverse and numerous challenges so that development and long-term goals are achieved without disruption. The armed forces are acknowledged as one of the most important elements of national power and the security apparatus. However, the debate on resourcing often tends to get overshadowed by the need to retain a balance between competing priorities or, indeed, the requirement of reducing 'unproductive' expenditure in a developing economy.

While the logic is sound, recent events around the globe have established the importance of the retention of hard power in an increasingly unstable world, with ever increasing dimensions of threats. These have also busted the theory that modern wars would be short and swift, and that international organisations would wield adequate influence to restrain belligerent nations. The inefficacy of this idea, and consequent destruction faced by nations, has been increasingly staring at us in the face and, by corollary, highlighting the need for self-reliant and improved defensive capabilities to ensure peace, safety, and development.

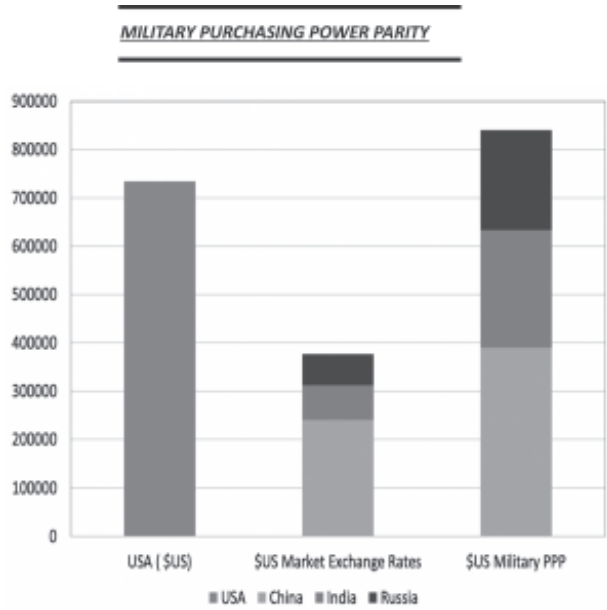
Economic Development and Military Effectiveness

The economic development of a country has a direct impact on a host of factors that range from its influence, security needs, economic strengths, technological prowess, industrial capabilities, human capital, access to and the development of natural resources, infrastructure development, and the evolution of a conducive policy framework. Each of these impact military effectiveness, directly or indirectly, and contribute to a nation's military might. The ability of an economically advanced nation to allocate more funds or resources for security does not automatically transform into better military capability. Material resources, at best, represent the potential of the nation, and it is the non-material resources that convert this potential into military strength and effectiveness. The organisational ability to apply the non-material and material resources for developing military effectiveness acts as a force multiplier, or dampener, and its importance needs to be well understood and honed. Sustained facilitation and attention to detail as the economy develops, with the aim of fine tuning the interplay between these, is an inescapable necessity to maximise output in the form of military effectiveness.

Military Purchasing Power Parity (PPP)

There has been substantial examination and debate on military PPP by a number of authors. In essence, the concept is a way to compare military expenditures across countries by accounting for the actual volume of goods and services that can be purchased by each country with its currency. This is different from using market exchange rates, which can undervalue the purchasing power of money in developing countries. The discussion centres around the distinctness of military purchases, and the usage of military PPP rates to ensure consistency over time, and some degree of international comparability. India's Defence Budget should, therefore, be worth much more when compared to advanced countries where the cost of manpower, R&D, maintenance as also production is much higher. A 2019 comparison carried out by 'Centre for Economic Policy Research (CEPR)', a non-governmental European research organisation, wherein defence expenditure of USA, China, Russia and India have been compared based on exchange rate and military PPP is reproduced at Figure 8.1.[1] The model estimates that, for the year 2019, Chinese military expenditure at currency exchange rates, is to be multiplied by 1.6, Russia by 3.2 and India by 3.4 to arrive at equivalence to US military expenditure.

Figure 8.1: Military Spending in Millions of US dollars, 2019 (Military-PPP and Market Exchange Rates)



The approximation is debatable since each country has different requirements, capabilities, and cost of equipment in service, as well as being acquired. In addition, comprehensive and complete data may not be available in the open domain. However, what is clear is that, at present, we have a relative advantage in both domestic revenue and capital expenditure as compared to countries where the cost of services and manufacturing is higher. The tendency to compare defence allocations with advanced countries needs to be moderated with the above in view.

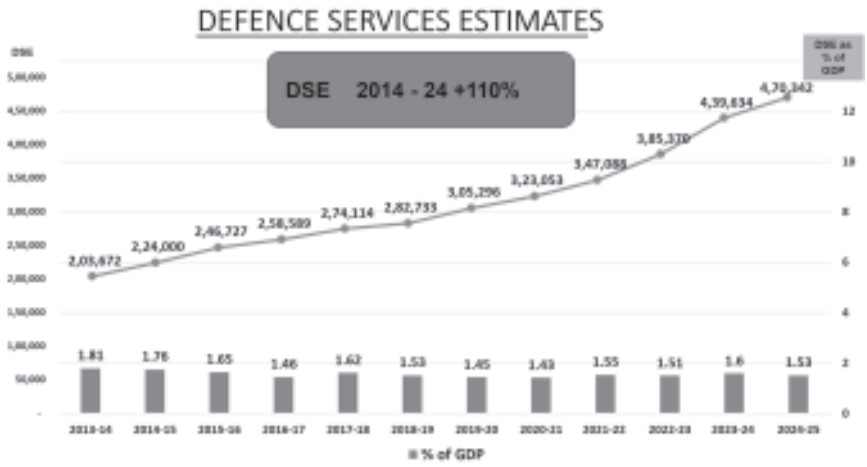
Availability of Funds

Over the years, the availability of funds for modernisation has consistently improved, and is not the constraint holding it back. The capital budget allocation is based on projected requirements that reflect the assessed delivery of equipment and infrastructure already contracted in previous years, with a much smaller percentage for new schemes likely to be contracted in that financial year. The capital allocation remains an ability to utilise, and is neither reflective of resolve nor intent. While the Government has remained committed to enhanced allocation under the capital head, a varying proportion of allotted funds continue to be surrendered due to a variety of factors that primarily include delays in delivery by

a maturing domestic defence industry, prolonged procurement processes, policy bottlenecks, and erratic supply chains affected by geopolitical events.

The value of the Rupee is commonly seen as depreciating. However, the depreciation of the Rupee against the US Dollar has been less than that of other currencies. While the Net Effective Exchange Rate (NEER) of the Rupee has reduced, its Real Effective Exchange Rate (REER), when viewed against a weighted basket of currencies, has appreciated marginally in the last ten years.[2] This indicates a reduction of export competitiveness, but bodes well for foreign defence purchases. The availability of funds to the defence services over the last 10 years is depicted in Figure 8.2. The absolute value of funds allocated has more than doubled in the last 10 years. At the same time, the proportion of allocation of the GDP and that of Central Government Expenditure have shown a downward trend.

Figure 8.2: Defence Services Estimates



(Data compiled from Budget Documents of Govt of India (Open source)

The issue of a Non-lapsable Defence Modernisation Fund has also been debated often since the 15th Finance Commission recommended its establishment. The funding methodology and, indeed, its very necessity, have not found consensus. This is more so in recent times, wherein capital allocations have been able to meet projected requirements. The fact that additional funds are required to create required capabilities is not debatable. However, a holistic approach, which improves systems and processes along with the defence industrial base, is critical for capability development with these additional funds.

Most planning and procurement of military capabilities is done on entry

level financing, with no prescribed tools for life cycle or technology relevance costing mechanisms. A significant proportion of funding in capital cases, including infrastructure, ammunition, support equipment, sustenance, etc., often ends up being managed through revenue funds, simply for reducing case value to hasten procurement. Such an approach artificially accentuates the 'Revenue to Capital Skew' in expenditure, and is counter-productive. The reduction of revenue expenditure, without affecting operational capabilities, requires serious and out of the box thinking. Disruptive thought and innovation that can reduce effectiveness of adversary strengths, would result in capability much beyond quantitative matching that is resource intensive. In addition, we need to seriously consider a simple solution recommended by the Kargil Review Committee and the Seventh Pay Commission, regarding lateral induction of officers and men from the armed forces to para-military forces, and in other government organisations. This would ensure that exiting trained and disciplined manpower, with substantial productive life remaining, does not simply add on to the pension burden at current age brackets. In addition, the armed forces have already resorted to the outsourcing of services that do not require combatant manpower. This can lead to substantial savings in the long run, if allowed to be implemented as per priorities identified by the armed forces themselves, without undue interference. The resources thus saved in the long term will certainly be available for modernisation, and development of additional capabilities.

Resourcing Research and Development

Innovation has proven to be a force multiplier in the conflicts around the globe. The criticality of resourcing technology development for defence needs, and the inescapable requirement of revamping the current R&D apparatus have been established beyond doubt. While funding is being looked at in detail, the fact remains that the gap between technology giants and us is massive. Just one company, Amazon, spent US $73.2 billion, approximately the equivalent of our defence budget, on R&D in the financial year 2023.[3] While it may not be prudent or feasible to catch up on all fronts, it is imperative to focus on building upon our strengths, focusing on critical areas, and developing disruptive cutting-edge technologies. No country will share the latest technology and, whatever they do, will be at a substantial premium, thus introducing additional costs as compared to indigenous technology.

A very significant increased investment on R&D as also the initial additional costs of developing an indigenous defence industry/ ecosystem have to be accepted

to ensure future self-reliance, efficiencies, and a competitive defence industry. The Hon'ble Raksha Mantri has, on a number of occasions, stated that the government recognises the need, and is willing to do what it takes for self-reliance. He summarised the resolve in the press release on December 31, 2023, 'New India no more tolerant of 'let it be' mindset & believes firmly in 'let's do it' approach'.[4] The implementation of the resolve involves hard decisions, and holds the key for development of the nation's overall strength.

The inescapable necessity to assume a leadership role in technology calls for a massive growth in the innovation culture. Spending on R&D as a percentage of GDP in India is estimated at only 0.6 to 0.7% as against USA 3.5%, China 2.4%, Germany 3.1%, South Korea 4.8%, and a massive 5.6% by Israel. These countries, and even many other smaller economies, maintain the edge in their core competencies and strengths, with massive focussed investments in R&D. India is in the process of developing a better R&D base, with various schemes and tax breaks having been implemented to incentivise the same. A detailed plan to revamp defence R&D and DRDO has also been implemented. The need of the hour is aggressive and coordinated R&D, with facilitation through progressively increased funding. The share of private investment in R&D in India is only about 36%, and needs to be pushed up through a collaborative approach between government agencies, academia, and industry, with substantial long-term incentives. The investments in R&D, and in fostering the innovation culture, will form the bedrock for a vibrant economy and, as an outcome, military capability, and effectiveness.

Sustenance in Prolonged Conflict

The fact that modern wars need not be short and swift, logically points towards the need to review the funding of the key sustenance thought processes and capabilities to build self-reliance, resilience, and surge capability. This would include investment in upgrading facilities, which are essential to generate and regenerate major equipment of the three services, in a prolonged war. The ability to recycle field damaged equipment in a shorter time frame provides an edge in a prolonged conflict.

In addition, it would be worthwhile to rethink the stocking and manufacture of expendables, such as ammunition to arrive at a sustainable model that caters for long lead production processes, and the augmentation of production at short notice. For example, a gun shell used by the army and navy or an aerial bomb, have a limited shelf life due to the explosive filled in it. It may be feasible to devise

a distribution for economical sustenance, wherein the minimum requirements are stocked fully completed and tested, while a proportion of completed empty shells, from each production lot, are kept hermetically sealed, ready for filling of explosive as the life of the steel is much more than that of the explosive. With suitable R&D, a similar analogy could be applied to other types of ammunition having a combination of long and short life components. This would reduce the cost of holding inventory, while simultaneously improving the time required for the commencement of sustained delivery during conflict—a win-win situation from all angles.

The Development of a Defence Industrial Ecosystem

Legacy practices have created a long-term import dependency, and the indigenous defence industry has had a delayed start. Incentivisation through policy facilitation for procurement and investment in innovation, from the grassroot level in academic institutions upwards, is critical to keep the development on track. A key enabler to efficiently convert available resources into capability is acquisition policy. While there is no denying the fact that procedures are essential to maintain transparency, accountability, and propriety, the actual aim of the policy is to create capability for the nation. We need to clinically examine the processes, public accountability, and regulatory compliance requirements that stretch execution cycles, and create bottlenecks introducing delays and inefficiencies. These delays, more often than not, result in dangerous consequences of denying capability when required, cost overruns, and technology sunset.

The fact that there is a need to re-orient procedures in favour of industry is borne out by the historical data of countries such as the USA and Japan which followed procedures in which over 50% of defence contracts, in the initial phases, were on single tender, or cost-plus incentive basis, with developing partners in domestic industry. These companies are national strengths and strategic assets for them today. Procurement policy facilitation, suited for Indian realities and requirements needs a hard look for betterment in the larger context.

Conclusion

Military effectiveness is the outcome of a very large number of factors. The cross linkages between economic development and military effectiveness are well established. As India emerges as a stronger economy, fund availability continues to improve. However, demands are likely to continue to exceed availability. The changing nature and contours of war demand agility in planning, the pragmatic

assessment of requirements, and the prioritisation to develop critical capabilities in synchronisation with available funds. The crucial issue is to develop self-reliance with a thriving indigenous defence manufacturing ecosystem that can meet the requirements of the defence forces in the future. This has to be based on a mindset oriented towards innovation, with pragmatic policy facilitation, incentivisation, and the creation of common use, high-cost infrastructure by the government. The aim has to be to develop agile and responsive startups, in addition to the larger system integrators. Incentivisation is critical to nurture the defence industry as a national asset, especially since private investment in defence is risky, needs policy facilitation, and may not have long term cash inflows. In the overall context, focus has to be retained on mobilising the entire gambit of material and non-material resources, in a 'whole of the nation' approach towards the common aim of developing overall strength.

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PART III

Navigating Domains of Wars: Addressing Operational and Administrative Challenges

9

Adaptive Defence: Operational and Administrative Challenges in Changing Maritime Warfare

S N Ghormade

The aim of this chapter is to explore the evolving dynamics of maritime warfare, the operational and administrative challenges we face, the path forward to effectively overcome them, and our strategic approach to achieving maritime dominance through innovation, technology, indigenisation, and committed leadership.

The Changing Nature of Maritime Warfare

Maritime warfare has undergone profound changes over the centuries.

- From the age of wooden sailing ships, it has evolved into a domain dominated by steel-hulled warships, nuclear-powered submarines, and formidable aircraft carriers.
- The 20th century saw revolutionary advancements, including naval aviation, radar systems, guided missiles, and integrated battle management systems. These developments not only transformed naval capabilities but also redefined the very nature of maritime conflicts.
- In the current century, we are witnessing an even more rapid transformation, driven by cutting-edge technologies such as Artificial Intelligence (AI), autonomous systems, cyber warfare, and space-based surveillance. The convergence of these technologies is leading to a new era of warfare where

traditional battle lines are blurred, and operations are becoming increasingly network-centric and multidomain simultaneously. Current hostilities across the world have amply demonstrated that militaries are employing distributed warfare—small, agile and well-armed platforms/teams able to achieve asymmetric advantage over a more capable adversary.

Emerging Defence Technologies

- Today's maritime domain is a complex battleground where both conventional and non-conventional threats coexist. The rise of non-state actors using high-end technology adds to this complexity, presenting new security challenges.
- For instance, in regions like the Red Sea, Gulf of Aden, Persian Gulf, etc., naval forces have had to counter asymmetric threats, such as unmanned surface/underwater vessels and remotely operated drones.
- Autonomous systems, including drones and uncrewed surface vessels, have proven their operational effectiveness in recent conflicts, as seen in the Armenia-Azerbaijan and Russia-Ukraine wars. These technologies have not only enhanced situational awareness but also allowed for precision engagements, thereby reducing the risk to the attacker.

Future Warfare

As we look ahead, the future of maritime warfare will be shaped by distributed and asymmetric strategies. It emerges that future warfare will be characterised by five cardinal aspects.

- ***Speed of Operations.*** To out-manoeuvre adversaries by reducing decision-making cycles and response times.
- ***Enhanced Battle Space Transparency***: Leveraging Command, Control, Communication, Computers, and Intelligence (C4I) systems to achieve real-time situational awareness.
- ***Precision Firepower.*** Utilizing advanced weapon systems to conduct cost-effective and sustained operations.
- *Low-cost weapons/sensors to target/damage large/expensive combatants/targets*
- *Sustained and long drawn conflicts*

These five cardinal aspects are only seemingly simple. However, it is important to understand the real implications of this concise list, which will be elaborated further in this essay. Thus, the future of maritime warfare through the prism of these aspects is governed by the following:

Battle Space Dynamics

The battlespace will be powered by,

- Artificial Intelligence-driven credible autonomy, with manned and unmanned systems
- Space & Cyber warfare capabilities
- Long-range detection capability
- Precision targeting
- Improved lethality

This transformation of the battlespace mandates competitive technological advancements in niche technologies, in order to deny the adversary an asymmetric advantage. This calls for a long-term perspective for indigenous technology development which is founded upon a sustainable financial strategy, which includes hardware as well as its enabling technologies to address the operational challenges.

The list of technology options, both essential and desirable, is bound to be long. The endeavour is to highlight only the core ones here, which are likely to change the face of maritime warfare as we know it. They are the key capability-development focus areas for our R&D agencies, planners, users, academia and industry in a time-bound manner.

Autonomous Systems

If we examine Autonomous Systems, the use of uncrewed, or partially-crewed, systems continue to grow at an exponential pace.

- It is well-accepted that these systems are best suited for the 'four D' missions, implying missions that are 'dull, dirty, dangerous, or dear'. Their employment for Command and Control, communication relay, battlespace awareness, force protection, ordnance delivery, and logistics is increasingly becoming commonplace. The impact of autonomous aerial vehicles in the Armenia-Azerbaijan and Russia-Ukraine conflict is clear. Reportedly, most UAVs used by Ukraine were simple, commercial drones, with integrated cameras that could be paired with smartphones.
- Their cost versus operational impact made them a preferred choice. These drones were also reported to be particularly effective in the defence of Kyiv in the early months of conflict.
- Uncrewed surface vessels (USVs) are fast proving their operational viability for military operations, including options of large weaponised autonomous vessels.

Hybrid Fleets

- The adoption of hybrid fleets—comprising both crewed and uncrewed platforms and the Manned Unmanned Teaming (MUMT)—will provide greater operational flexibility while reducing costs.
- Moreover, the integration of AI and algorithmic warfare will revolutionize mission planning, navigation, and autonomous target recognition.
- This shift, often referred to as the 'third revolution in warfare' after gunpowder and nuclear technology, will set the stage for a new era of maritime dominance.

Addressing Operational Challenges

The Indian Ocean Region (IOR) plays a pivotal role in the global maritime economy, acting as a critical conduit for maritime trade. Over 1,55,000 unique ships transit this region annually, accounting for about 66% of the world's oil traffic, 50% of container traffic, and 33% of bulk traffic. The presence of nearly 5.5 lakh fishing vessels and, on an average, 70-80 warships from extra-regional navies adds to the complexities of the maritime environment. Nearly all maritime trade today is multinational in nature, and a situation where the ship, the master, the crew, and the cargo—all belonging to different nations—is the norm, highlighting the transnational nature of maritime issues. This region's strategic importance cannot be overstated, as it is the lifeline for global energy supplies and trade routes.

Blurring of Lines: The Hybrid Nature of Threats

The maritime threat landscape is characterized by a multitude of non-traditional challenges, including maritime terrorism at (and from) the sea, piracy, robbery, theft at sea, drug smuggling, gun running, IUU fishing, human trafficking, including attacks on ships at sea. These include mines, unmanned remotely controlled boats, water borne Improvised Explosive Devices, and attacks by drones. With increased automation, cyberattacks on port and logistic infrastructure, and embedded systems onboard ships are more likely. These threats are often supported by state and non-state actors using sophisticated technologies.

Lessons from Russia-Ukraine War

The Russia-Ukraine war has provided valuable lessons on how conflicts can rapidly evolve.

- ***Integrated Air and Missile Defence (IAMD).*** The effectiveness of IAMD systems in neutralizing complex air and missile attacks has been a game-changer.
- ***Proliferation of Tactical Drones.*** The widespread use of drones has created partially transparent battlefields, constraining traditional forms of manoeuvre warfare.
- ***Electronic Warfare (EW)***: The scale and impact of EW capabilities have expanded dramatically, affecting communication, navigation, and sensor systems.
- ***Rapid Technological-Tactical Innovation.*** The rapid cycle of innovation, particularly in drone and EW technologies, underscores the need for agile and adaptive defence strategies. Unmanned aerial and maritime systems' successes in destroying high-value targets at low-cost to their operators are changing the character of maritime warfare.

Attacks by Houthis

The character of war is always changing, and the Houthis' attacks against shipping in the Red Sea through the application of long-range precision missile fire, and autonomous drone employment from the shore, using its strategic location and choke point, has to be understood in the maritime domain. The Houthis effectively blend a mix of anti-ship ballistic missiles, cruise missiles, and one-way attack drones to contest control over maritime lines of communication. They have, so far, damaged at least 30 merchant ships, sunk two, and killed or detained several merchant sailors.

Distributed Maritime Operations

The successful attack on Karachi by the Indian Navy in the 1971 war is a very good example of a Distributed Maritime operation that used surprise, available resources, and capability to lend a devastating blow to the Pakistan navy.

- Making greater use of longer-range weapons, unmanned vessels, and unmanned aircraft can also achieve such results.
- The use of resilient communication links and networking technologies to knit the resulting widely dispersed force of manned and unmanned ships and aircraft into a coordinated battle force that can withstand and adapt to enemy attacks on Navy communications and networks is also essential.
- Continuous ISR for effectiveness of Distributed Ops, the handling of

voluminous data, transmission, storage, analysis, and the dissemination of actionable inputs are most significant requirements.

- The secure and effective utilization of space assets is a domain that needs comprehensive planning with a large number of stake holders.
- The harnessing of the dual use nature of own assets, and addressing those of the adversary are also necessary; for example, research vessels, paramilitary forces platforms, Ships taken Up from Trade (STUFT), Illegal, Unreported and Unregulated (IUU) fishing etc.
- It is obvious that the security of networks, both physical and cyber, needs to be given utmost importance.
- The modern application of age-old concepts such as Camouflage, Concealment and Deception (CCD) will need to include the employment of digital measures to achieve the same effect.

Adaptive Approach

The lessons from these conflicts highlight the need for a flexible and adaptive approach to maritime warfare, where the speed of technological adoption can determine the outcome of engagements.

- There is a need to adapt to maintain a competitive advantage. Advances in technology and the changing character of war require that the plans address all domains, Joint Planning, Operations, and Inter Service Coordination.
- The planning must adapt to provide a perspective that views challenges holistically, and enables the execution of military campaigns with a flexibility and speed that outpaces the adversaries.

The Indian Navy has proactively enhanced Maritime Domain Awareness (MDA) through Mission-Based Deployments since 2017. Based on the requirements, the IN has ensured continuous presence in critical areas, such as the Gulf of Aden and the Strait of Hormuz, and has been able to shape the maritime environment, often deterring potential threats before they can escalate. However, the increasingly blurred lines between traditional and non-traditional threats pose significant operational challenges.

Addressing Administrative Challenges: The Human Element

- *Psychological warfare.* A great amount of thrust will continue to be given to psychological warfare. With the means of social media penetration increasingly available, this becomes much more relevant now.

- *Leadership.* There is an urgent need to further develop leaders capable of thriving at the speed of war. Leaders who can adapt to change, drive innovation, and thrive in uncertain, chaotic conditions are the need of the hour. Again, the nature of war has not changed; but in a violent clash of wills, it is the human dimension that ultimately determines the success of any campaign.
- *Motivation.* Another important factor remains motivation. The reason adaptation in war occurs, or even triggers a conflict despite the odds being stacked against one side, is because of motivation. The desire to win, or at least the drive to impose costs against an adversary that enjoys considerable advantages, is what triggers conflict, and also prolongs it.

Maritime Capability Building: Indigenization and Capability Building

- To secure our maritime frontiers, it is essential to build a naval force structure that aligns with India's geopolitical and economic aspirations, and adapts technology at the pace it is developing.
- Indigenization, of course, is a critical component of this vision.
- The Maritime Capability Perspective Plan of the Indian Navy has already innovation and indigenisation incorporated in it. This transformation emphasizes indigenous design, development, and acquisition, fostering self-reliance in critical areas of technology.
- A Top-Down Capability Dominant, Threat cum Mission based approach to Force Planning is essential to deal across the entire spectrum of warfare; that is, from a low intensity conflict to nuclear war.

Revamping Defence Acquisition and Industrial Collaboration

The Defence Acquisition Procedure (DAP-2020) has laid the groundwork for promoting indigenous defence production. The introduction of the 'Make' procedure, encompassing categories like Make I, Make II, and Make III, is aimed at boosting private sector involvement in defence manufacturing. In the Navy, the Naval Innovation and Indigenization Organization (NIIO) and Technology Development and Acceleration Cell (TDAC) have been created to facilitate focused interaction with industry and academia, accelerating the pace of innovation.

Despite these efforts, challenges persist. Limited investment in R&D, dependence on foreign technology, and the need to enhance shipyard productivity,

along with other systems, remain areas of concern. By assuring orders to the private sector, and adopting a *Best-value Approach* instead of the traditional L1 model, a more dynamic defence industrial base can be created.

Importance of Adaptation: Maritime Strategy

- *Necessity of Technological Integration.* The continuous incorporation of emerging technologies is vital for maritime forces to enhance operational capabilities and maintain superiority in modern maritime conflicts.
- *Strategic Flexibility Requirement.* Maritime forces must develop adaptable doctrines and operational frameworks to effectively counter evolving threats and ensure readiness against diverse adversarial tactics.
- *Geopolitical Awareness Imperative.* Understanding the dynamic geopolitical landscape is crucial for Maritime strategies, enabling forces to anticipate changes, and respond proactively to international security challenges.

The Way Ahead

There is a need to develop a robust defence industry, and aggressively begin incorporating technologies such as drones, etc., into all three services. Here, speed is of essence. Joint ventures between Indian and foreign companies to develop new drones, and produce existing ones under licence, are a must. For such ventures to ultimately make commercial sense, more progressive procurement procedures that help fund research and development, and assure orders are needed. A Minimum Order Quantity is a must to ensure that such ventures succeed.

There is need to bring in doctrinal changes in war fighting by fully embracing the new technologies. To understand the transformative potential of technology, as well as its limitations requires a culture of informed and largely open debate, which involves military professionals, civilian analysts, and industry. Here, there is an urgent need for *civil military fusion*.

Whilst there is a need to invest in developing advanced military technologies, it is a must also to exhort the public sector, Defence Research and Development (R&D) organisation, private industry (including Startups and Entrepreneurs), and academia to work in concert with the Armed Forces service branches of the Indian military to develop innovative low-cost technologies that can be employed effectively on the battlefield.

There is a continuous need to nurture the Right and Committed leadership that will ensure adaptation at the speed necessary, and achieve success.

Conclusion

To navigate the complexities of future maritime warfare, there is a need to remain committed to the spirit of 'Atma Nirbhar Bharat', as that is the only option. Through adaptive defence strategies, technological empowerment, and the pursuit of self-reliance, the operational and administrative challenges that lie ahead can be addressed.

10

Command Intuition and Battlefield Effectiveness: From the Peloponnesian War to the Russo-Ukrainian War

Pascal Vennesson

Introduction: Why Thucydides Matters[1]

Why does the expert intuition of generals help achieve battlefield effectiveness in some cases, yet prove disastrous in others? Generalship is a core dimension of the art of war, and figures prominently in Thucydides' account of the Peloponnesian War. Surprisingly, however, compared to his observations on hegemonic wars, alliance politics, or democracy and foreign policy, his theory of command decisions has received less attention. In this essay, I argue that Thucydides, anticipating key insights of the cognitive psychology of expert intuition, formulated a proto-theory of command decision and battlefield effectiveness, that I call 'command intuition theory.' The theory highlights three conditions for the intuition of generals to increase battlefield effectiveness: their experience, the stability and validity of central features of their operational environment (the enemy and geography), and the opportunity to adapt through learning (reliance on routines of proven value) and innovation (generation of new solutions). I make this theory explicit, and probe its plausibility in the case of the Hostomel battle at the onset of the war in Ukraine.

Command Intuition Theory: Experience and Operational Environment

Thucydides' ideas on command decisions are not merely an eclectic collection of

interesting insights about leadership. Combined with key findings from cognitive psychology, they form a novel and elegant explanatory framework that offers a new understanding of the ways in which expert intuition-based command decisions affect battlefield effectiveness. By command decisions, I mean the decisions involved in the operational art, understood as 'the cognitive approach by commanders and staff—supported by their skill, knowledge, experience, creativity, and judgment—to develop strategies, campaigns, and operations to organize and employ military forces by integrating ends, ways, and means.'[2] Command intuition theory has three components presented below: the importance of expert-based intuition, the experience of the commander and his soldiers, and the operational environment.

Expert Intuition

For Thucydides, battlefield effectiveness often hinges on the ability of military leaders to use their expert intuition in identifying and seizing critical moments (*kairos*).[3] To take only one example, during the siege of Amphipolis, the Spartan general Brasidas judged at a glance from the movement of their spears and heads that his enemies were about to retreat. He immediately ordered a sortie, which took the Athenians by surprise (5.10.5-6).[4] Thucydides' view about the significance of commanders' expert intuition is consistent with what cognitive psychologists who study real-world crisis expert decision-making have established theoretically and empirically.[5] A growing body of psychological evidence indicates that military leaders often rely on their expert intuition as they make key operational decisions.[6]

Experience

Thucydides considers that the capacity of expert intuition of military leaders to help quickly and effortlessly recognize situations and decide is enmeshed in their experience (*empeiria*), generally related to their craft (*technè*), and knowledge (*épistémé*).[7] Military experience refers to a continuous and extended engagement in warfare, and the lessons derived from particular circumstances such as a terrain or a tactic.[8] At the broadest level, experience produces more skilful, effective military leaders and soldiers which is the key to victory (6.72.3, 6.36.3). Specifically, experienced-based expertise makes possible fast decisions and bold choice whereas those who lack practice 'will grow more clumsy, and consequently more timid', (1.142.8, 5.7.2) By contrast, the lack of experience is a source of mistakes and biases in judgements (2.35.2). The experience-based expert knowledge of military leaders is interwoven with the experience of their troops, exemplified by Athens'

expert rowers and Sparta's expert hoplites. In that sense, command decisions have both an individual-leader dimension as well as a collective dimension grounded in distributed expertise regarding key skills (such as rowing) and a capacity for innovation and improvisation.[9] Courage has its part, but Thucydides insists that, for commanders in particular, it is insufficient: the will to fight must be articulated in experienced-based knowledge (6.69.1).[10]

Experience is the result of lengthy, deliberate training and practice, and he emphatically contrasts a 'long experience' and a 'little practice', (2.85.2, 1.121.4. See also: 1.18.5, 2.85.2). Experience is not innate; it can be acquired and increased, even if it takes time (6.18.6, 11). If not regularly tested and updated, the value of one's experience will decline. Moreover, the building up of skill by the enemy over time as well as successful institutional imitation can reduce one's experience-based performance advantage. Thucydides acknowledges that a war-oriented education and a general experience of warfare are important. Yet, because military expertise is fractionated, a more specific experience is often necessary, such as familiarity with naval (as opposed to land) warfare, an understanding of specific types of operations (night attacks or siege warfare) as well as knowledge of particular operational environments (topography, weather). Thucydides ideas about experience anticipate what psychologists and sociologists have demonstrated theoretically and empirically.[11] Extensive experience in a domain is necessary to achieve high levels of performance, including in the military profession.[12] Inversely, novices tend to be more overconfident and make riskier decisions.[13]

Operational Environment: Stability and Validity

Although Thucydides claims that the commander's experience is necessary to make effective expert intuition-based decisions, it is not sufficient (3.95.3, 4.34.2).[14] Its effects on battlefield effectiveness depends on specific operational environments, understood as 'a composite of conditions, circumstances, and influences that affect the employment of capabilities and bear on the decisions of the commander.'[15] He focuses on two central dimensions of their operational environment: the enemy, and the geography of the theatre of operations.[16] Expert intuition can only develop and increase battlefield effectiveness in an operational environment of sufficient stability and validity.[17] One could object that, in war, the operational environment is never stable and valid and, therefore, that it is an illusion to trust expert intuition. Warfare is not chaos, however. While general friction is pervasive, the history of war reveals considerable variation in degrees of stability and validity of operational environments.[18]

Command Intuition and the Battle for Hostomel Airport

Battle for Hostomel Airport: Background

The Battle for Hostomel Airport was one of the key battles during the initial phase of the Russian invasion of Ukraine. Russian forces conducted an airborne assault on Hostomel Airport (also known as Antonov Airport), with the objective of securing the airport as an airbridge to support their efforts to capture Kyiv. Located a mere 10 km from Kyiv, Hostomel Airport would have served as a strategic base for Russian forces to launch an attack on the Ukrainian capital. Thus, securing the airport was an integral part of Russia's plan to capture the capital and force a quick capitulation.[19] However, despite their numerical advantage and superior equipment, Russian forces were unable to decisively capture the airport. Although they managed to seize the airport from the initial Ukrainian defences, they faced a decisive counteroffensive which saw the Ukrainians regain control of the airport. Analysts generally agree that Russia's inability capture the airport decisively as well as the strong Ukrainian resistance faced by Russian forces advancing on Kyiv, contributed to Russia's failure to capture the capital, and secure a swift victory as they had planned.[20] Thus, the Battle for Hostomel Airport had major strategic implications on the outcome of the initial Russian invasion of Ukraine, and is therefore worth analysing in-depth.

Command Intuition Theory and the Battle for Hostomel Airport

Experts generally agree that the Battle for Hostomel Airport, as well as the broader strategic failure suffered by Russia during its initial invasion of Ukraine, can be attributed to effective decision-making on the part of the Ukrainians, as well as blunders committed by the Russians. Both sides of the story offer potential pathways to apply CIT to explain and analyse key decisions and outcomes. Here, I will highlight some instances where the key principles of CIT (expert intuition, experience, operational environment, and adaptation) can be used to explain Ukrainian strategic success at Hostomel Airport (The applicability of CIT to Russian failures in the initial phases of the war will be discussed in a subsequent section).

Intuition and Experience

On the Ukrainian side, CIT can be applied to explain their successful counteroffensive after Russian forces had captured the airport from the defensive troops stationed to protect the airport. In particular, according to Sonne et al. of

The Washington Post, after the Russians had occupied the airport, Ukrainian military leadership quickly saw the danger posed by a potential Russian airbridge at the airport. Thus, the then Commander-in-Chief of the Ukrainian Armed Forces, General Valerii Zaluzhnyi, ordered the forces on the ground to swiftly organize a counterattack to retake the airport.[21] An argument can be made that the decisiveness and effectiveness of the Ukrainian counteroffensive can be, in part, attributed to the intuition and experience of Ukrainian military leaders. According to various reports, the attacks had taken the Ukrainians by surprise, and the defensive forces stationed at the airport were outmatched by the Russians, both in terms of equipment and manpower. Therefore, Ukrainian commanders did rely on their intuition and experience to recognize the strategic implications of the situation, and react swiftly.[22] This can also be said of the rank-and-file soldiers. Analysts generally report that Ukrainian soldiers involved in the battle, albeit lacking battle experience, were well-trained and, therefore, able to respond to the Russian attacks effectively.[23]

Although the extent to which Ukrainian forces were unprepared for the attack is contested, most reports concur that they did not expect the invasion to happen when it did. For instance, Major Vitalii Rudenko (Commander of the Hostomel airport garrison) reported that he was 'unaware of approaching helicopters until he heard the chopping of the helicopters' rotor blades'.[24] Therefore, the ability of Ukrainian forces to overcome their disadvantageous position, and launch a successful counteroffensive to re-capture the airport can be attributed to the intuition of their military commanders, as they were able to identify and seize the critical opportunity to respond to the Russian attacks.[25]

Operational Environment

Intuition alone, however, was not the only factor influencing the outcome of events at Hostomel airport. Ukrainian forces were also able to make use of the operational environment: not only were they operating in familiar territory, they also modified the environment to their advantage. For instance, Ukrainian forces placed large vehicles and other obstacles on the runway to prevent Russian aircraft carrying reinforcements from landing and, while retreating, managed to destroy crucial infrastructure, rendering the airfield inoperable.[26] This was crucial for the success of their subsequent counteroffensive, as Russia was unable to deliver reinforcements to defend the airport, allowing the counterattacking Ukrainian forces to encircle and bombard the occupying forces at the airport.

Adaptation

Finally, the fact that Ukrainian commanders were made aware of opportunities to adapt their skills and plans was another key reason for their strategic success. Ukrainian leaders took advantage of Russian blunders, both at the airport itself and in other areas of operation, to re-capture the airport from the vulnerable occupying forces. This is evidenced by the fact that although the initial defensive forces at the airport were forced to retreat due to a lack of ammunition, Ukrainian commanders were able to reorganize and launch a counterattack with heavy artillery and increased manpower to re-capture the airport.

'Command Intuition Theory' and Russian Failures

Russia failed to achieve its strategic aims of capturing Kyiv, and forcing a swift capitulation during its initial assault. Most analysts attribute this failure to poor strategic planning, low combat readiness, and logistical deficiencies.[27] In particular, experts point towards the decision by Russian military leaders to launch an airborne assault in enemy territory without having adequately disarmed Ukrainian anti-air defences, as well as the prioritisation of speed rather than overwhelming force in the form of a combined-arms offensive targeting the Ukrainian capital as key reasons for their strategic failures.[28] In this regard, the Russian failures at Hostomel, and during the initial invasion of Ukraine, reveal the limits of command intuition. However, this does not necessarily make CIT less viable; rather, it was a case of the conditions which tend to increase the positive impacts of command intuition not being met.

Experience

Although the Russian troops involved in the initial invasion were considered elite and well-equipped—such as the VDV airborne troops involved in the Battle for Hostomel Airport—many experts have suggested that they lacked adequate training in the specific types of operations. Additionally, any advantage that could have been gained from the experience of the troops was blunted by the fact that, as evidence suggests, many Russian soldiers were kept in the dark about the operation, and were not adequately prepared for the invasion.[29] However, history shows that Russia is, in fact, experienced with these types of operations. As Collins, Kofman, and Spencer highlight, there have been various occasions where the Russian military utilized airborne assaults to capture airfields in support of their mission of securing a swift victory. Most recently in Crimea, for instance, Russian troops captured the airport at Simferopol, subsequently using it to airlift troops and logistics in

support of their operations in Crimea.[30] Yet, it may have well been the desire to replicate such operations without due consideration of the specific circumstances in Ukraine, which resulted in their failures. Thus, the failure of command intuition to have a positive impact on the battlefield was not primarily due to a lack of experience, but the improper application of this experience.

Operational Environment

From the lens of CIT, the Russian failures can be attributed to a chaotic operational environment, and the failure of Russian forces to create a more stable environment. Prior to the invasion, the failure of Russian intelligence operatives to provide an accurate and complete picture of the situation in Ukraine, resulting in the poor planning and decision-making of Russian leaders. Although Russian intelligence presence in Ukraine had spiked in the months leading up to the invasion, experts report that Russian officials erroneously concluded that they would face limited resistance from the Ukrainian people and leadership—an assumption which was quickly proven wrong by the resolve and determination demonstrated by the Ukrainians during the initial invasion.[31] As a result, the Russians opted for a high-risk strategy that left their forces exposed and vulnerable to counterattacks, without adequate reinforcements and logistical support.[32] Thus, the miscalculations made by Russian leaders in planning the assault were fundamentally grounded in a lack of understanding of the operating environment. Because they only had incomplete or inaccurate information, they were unable to tap into their experience and intuition to make effective planning decisions.

Adaptation

During the initial stages of its invasion, Russia also failed to adapt its tactics and strategies in light of the lack of success it faced. Given that Russia's entire military strategy was based upon flawed assumptions, their operational failures naturally took them by surprise as they had not expected to struggle as much as they did in achieving their strategic aims. However, in spite of these surprises, analysts have commented that the Russian military failed to adapt their strategies, resulting in their humiliating failures during the initial phase of the war. For instance, at Hostomel Airport, the Russian troops which seized the airport initially, were unable to hold on to it as reinforcements were unable to reach them due to the damage caused to the runway, as well as the presence of Ukrainian air defences.[33] The Russian military's failure to adapt to the changing situation, and find alternative means of supplying the occupying troops with reinforcements meant

that the Ukrainians were able to re-capture the airport in the same day. Elsewhere, similar blunders were observed: various experts have highlighted how Russian forces failed to adapt their manoeuvring tactics in response to Ukrainian heavy artillery, as well as the lack of a proper Suppression of Enemy Air Defences (SEAD) plan to deal with Ukraine's extensive air defences.[34] Although Russia has since overcome their adaptation issues, it is clear that the slow nature of their innovation and adaptation during the initial phases of the war greatly contributed to its lack of success.[35] Thus, CIT allows us to understand how this lack of adaptation renders the intuition of commanders ineffective.

Conclusion: Command Intuition Theory in the Age of Artificial Intelligence[36]

Machine learning (ML) is increasingly integrated into military decision making to enable leaders to make more efficient and effective decisions on the battlefield. It submits that ML capabilities allow strategists to study data sets and information to extract patterns and insights at a scale and efficiency that would not be possible if conducted by humans, making it a potentially invaluable tool for operational-level decision-making. Thus, ML actually complements Command Intuition Theory by strengthening the conditions which enable the intuition of commanders to guide effective decision-making. However, the report is careful to note that the integration of ML into military decision-making has its limitations: chiefly, ML relies on human direction to select the relevant data sets and parameters, and humans ultimately need to translate ML outputs into decisions.

ML not only provides commanders with a higher volume of information, but it also more efficiently pinpoints relevant information, based on set parameters. Thus, it can guide commanders to make decisions that are more accurate and effective, in a more efficient manner. Since intuition is the process of recognizing patterns in order to make quick judgements, ML can help commanders recognize these patterns even quicker. Moreover, the information provided by ML models can help 'stabilize' the operational environment by maximizing information clarity, and painting a sharper picture of the battlefield. For instance, the report includes a fictional case study in which it is proposed that a ML model be produced to map the levels of violence in the Donbas region, in order for commanders to determine how and when to react to insurgent threats. Finally, ML also complements the 'adaptation' condition of CIT, as it helps leaders identify crucial opportunities to adapt their decisions, and can also suggest the best course of

action to do so. All in all, the capability of ML to process information and recognize patterns makes it an invaluable aid to the intuition of commanders.

Of course, utilizing ML in decision-making has its limitations. In particular, the report highlights the importance of a 'human-machine collaborative' approach to harness the capabilities of ML. Ultimately, effective human direction and analysis is crucial for the successful implementation of ML. Although ML can be a useful tool to process large amounts of data, human input is required to determine which sets of data are important. Furthermore, to aid in pattern recognition, humans need to provide ML models with the correct parameters so that they can effectively process and produce useful information. There, ML should not be treated as a replacement for humans. While it can bolster the effectiveness of the intuition commanders, they must still rely on their experience to provide direction to ML systems, and identify the relevant implications of the information produced by ML. As highlighted by Thucydides, experience is the result of extensive training and practice, and can only be increased with time. ML can serve as an effective tool to harness experience, but it cannot completely replace the experience-building process. Therefore, the authors of the report advocate for a 'systems approach' in the implementation of ML, such that it enables a 'standardized, objective, and long-term' usage of ML in order to increase the effectiveness of operational decision-making.[37]

NOTES

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PART IV

Age of Disruption: Transformative Technologies in Modern Wars

11

Law and Ethics in the Governance of AI-enabled Military Systems

Rain Liivoja

The Rise of Military Artificial Intelligence

Artificial intelligence (AI) has found its way into military systems. Considering the rapid rate at which machine learning, natural language processing, and computer vision are being developed and adopted for civilian purposes, it would be surprising if the defence sector did not adapt the same technologies for its idiosyncratic purposes.

The scale and impact of the 'AI revolution' in the military, however, remains difficult to gauge accurately. For one, the speed of technological change puts any overview or analysis at the risk of being instantly out of date. Second, governments and armed forces do not disclose the precise extent of the development and implementation of military AI—for reasons that are all too obvious. Third, the defence industry, which has a commercial interest in being more forthcoming, may be embellishing or overselling the capabilities that they develop.[1]

Much of the public debate has centred on the use of AI in weapon systems or, as of late, decision support systems in the targeting cycle.[2] But there are other applications that may be equally significant. For example, the use of AI may help optimise military logistics, the complexity and importance of which is often underappreciated. To give another example, the use of wearable sensors by warfighters, which allows the armed forces to have better real-time data about their health, may potentially enable AI-supported triage in circumstances where warfighters are injured, and require medical assistance.

In short, the range of potential military applications of AI is extremely broad.[3] Essentially, wherever the armed forces have a data problem, or a problem that can be reduced to a data problem, AI has the potential to be part of the solution.[4] India has been at the forefront of thinking about how to utilise AI in the military context. Notably, India set up a Defence AI Council and a Defence AI Project Agency in 2019 and, shortly thereafter, published a lengthy list of applications of military AI that it considered particularly significant.[5]

Risks and Regulation

Any use of new technology carries risks. AI is no exception. The risks are particularly notable in the military context, where consequences of the risks materialising can be very serious.

Using AI for military or national security purposes involves a range of different risks.[6] Some of them are common with other AI systems. There are, for example, general safety risks, including the problem that AI systems can be brittle such that they stop functioning properly, or even fail spectacularly, outside the circumstances or parameters for which they were designed. There are also general human-machine interaction risks, such as the possible over-reliance on AI-based systems (so-called automation bias).

There are also unique risks in the defence and national security context. For example, the speed at which AI systems operate can lead to escalations in conflicts that are very difficult to reverse. Also, the proliferation of AI-based systems to nefarious actors is a significant concern. As Prime Minister Narendra Modi put it in his address to the inaugural Global Partnership on Artificial Intelligence Summit in December 2023, '[i]f AI equipped weapons reach terrorist organizations, it will have a huge impact on global security'.[7]

Regulatory Debates

The enthusiasm of the armed forces for AI on the one hand, and risks on the other, have fuelled calls for developing a governance framework for military AI, or for autonomous weapon systems (AWS) (especially those utilising AI).

The intergovernmental dialogue on this issue kicked off in 2013 with a report produced by Christof Heyns in his capacity as the United Nations (UN) Special Rapporteur on Extrajudicial, Summary or Arbitrary Executions.[8] In the report, submitted to the UN Human Rights Council, Professor Heyns recommended developing an internationally agreed upon framework for what he dubbed 'lethal

autonomous robots', and called on States to place a moratorium on their development as an interim measure.

The Human Rights Council did not debate the recommendations in any detail; rather, the topic was taken up in a specialist body: the Meeting of High Contracting Parties to the Convention on Certain Conventional Weapons (CCW). After a series of informal discussions, a Group of Governmental Experts (GGE) was established under the Convention's auspices, and this group has been working on the governance of AWS for some 10 years. While the focus of the GGE has not been expressly on AI-enabled weapon systems, the interventions made by different stakeholders suggest that such weapons are at the forefront of their minds. The most significant outcome of the GGE process, so far, has been the adoption of a set of guiding principles in 2018 and 2019.[9] Notably, this would not have been possible without the leadership and diplomatic skills of the GGE's then chair, Ambassador Amandeep Singh Gill, India's Permanent Representative to the Conference on Disarmament.

As the GGE's focus has been rather narrow, and its subsequent progress towards a regulatory 'instrument' quite slow, the past three years have seen a mushrooming of other governance initiatives. For one, the Human Rights Council has again become seized of the issue, and commissioned a study examining the human rights implications of new and emerging technologies in the military domain.[10]

The UN General Assembly has also started addressing AWS. In 2022, 70 States delivered a joint statement in the Assembly's First Committee, recognising the importance of elaborating the normative and operational framework regulating AWS, including through internationally agreed rules and limits.[11] In 2023, the General Assembly requested the UN Secretary General to produce a report that reflects the views of States around the world on the governance of AWS.[12] The Secretary-General duly submitted the report in 2024.[13] The Assembly then decided to commence informal consultations on AWS in 2025, with these consultations being open to all States, and not just those participating in the CCW framework as High Contracting Parties or Observers.[14]

There has been an increased focus on military AI more generally, which plainly reflects the rapid development in AI over the past couple of years. For one, the United States has sponsored a Political Declaration on Responsible Military Use of Artificial Intelligence and Autonomy, which articulates a series of 'measures' that should be implemented in the development, deployment, or use of military AI capabilities.[15] Roughly, 60 States have endorsed the Declaration.[16] Furthermore,

the Netherlands and the Republic of Korea have convened major summits on the Responsible Artificial Intelligence in the Military Domain (REAIM) in 2023 and 2024, which have resulted in two significant public declaration that have likewise attracted the support of about 60 States.[17]

Finally, the UN General Assembly is now also looking into the governance of military AI. Along already familiar lines, the Assembly has asked the Secretary-General to seek the views of States on 'on the opportunities and challenges posed to international peace and security by the application of artificial intelligence in the military domain', and to submit a substantive report summarising those views, as well as existing and emerging normative proposals, to the Assembly at its next session for further discussion.[18]

In short, while in 2013 there was some thinking about the question of military AI governance in a very limited sense and in a specific expert body, there are now at least six parallel intergovernmental initiatives attempting to address the use of AI in the military context.

Principles

Several of the international initiatives just mentioned have resulted in sets of principles, with slightly different foci and varying degrees on generality, on the ethical or responsible use of AI in military systems. These principles mirror those contained in documents that States or alliances have produced with a similar objective. Notably, in 2020, the United States Department of Defense adopted a set of five 'Ethical Principles for Artificial Intelligence'.[19] In 2021, NATO adopted an AI Strategy which, among other things, endorsed six 'Principles of Responsible Use' for AI in Defence.[20] In 2022, the United Kingdom Ministry of Defence published a policy paper titled *Ambitious, Safe, Responsible*, annexed to which was a set of five 'Ethical Principles for AI in Defence'.[21]

As Table 11.1 demonstrates, these documents have a significant amount of commonality, suggesting that there is some quantum of shared understanding around certain key principles that should govern the use of AI in the military context. For example, all these documents reflect the need to ensure human responsibility and accountability, and the proposition that AI systems used by the military should be reliable, and their effects traceable to environmental and other triggers.[22]

Table 11.1: Principles on the Ethical or Responsible Use of Military AI[23]

US (2020)	*UK (2022)*	*NATO (2021)*	*Political Declaration (2023)*	*REAIM Blueprint (2024)*
		lawfulness	consistent with international law	accordance with national and international law
	human-centricity		context-informed judgments	ethical and human centric; appropriate human involvement
responsible	responsibility	responsibility and accountability	accountable; oversee	responsible and accountable
equitable	bias and harm mitigation	bias mitigation	minimise unintended bias; mitigate risks of failures	reduce risk of malfunctions or unintended consequences, including from data bias
traceable	understanding	explainability and traceability	transparent and auditable; understand	understand, explain, trace and trust; explainability and traceability
reliable	reliability	reliability	explicit, well-defined uses; safety, security and effectiveness	reliability and trustworthiness
governable		governability	ability to respond	

Ethics and Law

This proliferation of principles raises the question of how they relate to the existing law of armed conflict, which forms the basis for rules of engagement issued to armed forces, and which are taught in military academies around the world.

Before getting to the specifics, it is worth briefly reflecting on the general interaction between the law that applies in armed conflict and the ethical principles applicable in warfare. To be clear, I do not intend to get into the age-old debate about the precise relationship between law and morality. Nor is this the right place for a comprehensive examination of the relationship between the law of armed conflict and the military ethics of warfare.[24]

That said, ethical discourses can influence law in that they can lead to the creation of new legal instruments, or they can change State practice, which then hardens into unwritten customary law. It is probably not an exaggeration to say that the first contemporary legal and policy instruments on the law of armed conflict, adopted in the mid-1800s, were largely a codification and reflection of military customs and concepts of professional military ethics prevailing in the Western armed forces at the time. Conceptions of ethical or moral behaviour in

war have continued to inform the development of the law of armed conflict over the past 170 years of treaty-making.

In some circumstances, law can incorporate ethical standards, and prohibit actions that are not in conformity with those ethical standards. Perhaps most obviously, the disciplinary rules applicable in many armed forces proscribe conduct prejudicial to good order and discipline, and sometimes also to dishonourable conduct. Such rules have the effect of making punishable conduct that falls short of ethical and professional standards applicable in the armed forces. In effect, the law incorporates prevailing notions of ethics.[25]

The modern law of armed conflict also contains a few hatches through which non-legal social norms can enter the legal systems, and directly affect the substance of legal regulation. The prohibition of treachery is one example—as I have argued elsewhere, the kind of deceptive or dishonest behaviour that amounts to prohibited treacherous conduct can only be properly canvassed by reference to the military tradition and ethics prevailing at a particular point in time.[26]

But it is the Martens Clause that supplies the most obvious and widely discussed example of ethics and morality seeping into the fabric of the law. The clause can be found in many treaties on the law of armed conflict and, in its contemporary iteration, the clause provides that in cases not covered by international agreements, 'civilians and combatants remain under the protection and authority of the principles of international law derived from established custom, from the principles of humanity, and from the dictates of public conscience.'[27]

There are widely diverging views as to what this means under contemporary conditions.[28] Some States argue that the clause no longer has any practical normative effect. Other States suggest that the clause merely preserves the existence of customary law as a discrete source of law alongside treaties. But many States, plainly attributing a more substantive role to the clause, have regularly underscored its importance in the ongoing debates about the regulation of AWS.

The Role of Ethical Principles on Military AI

So where does this leave us with respect to the various principles of ethical or responsible use of AI?

What is clear is that the principles do not modify existing international law. For one, they are incapable of doing so. A change in the existing international law would require treaty action (which has not happened), or a change in State practice

and accompanying *opinio juris* that would generate a shift in customary international law (for which there is no evidence). Also, some of the principles incorporate a reference to lawfulness, thus recognising the obligation to comply with existing law as it stands. Finally, some of the principles actually make it clear that they are not intended to have legal effect. For example, the UK policy is clear that '[t]hese ethical principles do not affect or supersede existing legal obligations. Instead, they set out an ethical framework which will guide Defence's approach to adopting AI, in line with rigorous existing codes of conduct and regulations.'[29]

But that is not the end of the matter. While the UK statement about the domestically promulgated principles not affecting existing legal obligations is undoubtedly correct, the situation becomes more complicated when such principles or concepts become endorsed by large groups of States. Admittedly, these States are also not engaged in the making of new international law but, arguably, at least two legally significant things can happen.

For one, the various ethical principles may start to give meaning to the notion of 'dictates of public conscience' as contained in the Martens Clause. Indeed, the principles of responsible conduct developed through multistakeholder processes, and agreed upon by substantive numbers of States, are a better way of gauging public conscience than, for example, opinion polls.

Second, the principles may affect the way in which States interpret flexible standards under the law. The prime candidate here is the so-called precautionary principle, according to which 'in the conduct of military operations, constant care shall be taken to spare the civilian population, civilians, and civilian objects.'[30] This principle is nebulous to say the least—scholars have questioned its status as a customary international law rule, and its application to military operations other than attacks.[31] Principles of ethical or responsible conduct may, therefore, helpfully clarify what 'constant care' entails in a specific technological context.

What is perhaps of more immediate significance is the extent to which these various ethical or responsible use principles already overlap with the existing law. I would suggest that there is, in fact, a fair amount of overlap. For example, the ethical notion of human responsibility over military AI is backed up by current international law. The law requires States to suppress and repress breaches of the law of armed conflict, and to take penal measures against persons who violate the legal rules that apply in an armed conflict.[32] There is also the duty of commanders to prevent misconduct, and the responsibility that commanders incur for certain types of misconduct of their subordinates.[33]

Likewise, the ethical notion of AI having to be reliable and predictable is backed up by certain legal standards. The law of armed conflict requires commanders, for example, to minimise the amount of collateral damage caused by a particular attack, and to cancel or suspend that attack if that collateral damage would be disproportionate.[34] Thus, the law requires military commanders to anticipate what the effects of an attack would be, and to manage those effects. This would not be possible with weapons that are unpredictable and unreliable.

Conclusion

Considering all of this, what to make of the principles or ethical or responsible use of AI, and the surge of 'principle-making' in the context of military AI? Let me start with the negatives.

First, there is a risk that the principles reflect a Western conception of what is responsible and what is ethical. But that is not exclusively the case. The 2024 REAIM summit was co-sponsored by the Republic of Korea, the Netherlands, the United Kingdom, Singapore, and Kenya. The list of States endorsing the REAIM Blueprint for Action additionally included Brunei, Ethiopia, Ghana, Japan, Kenya, Mongolia, Morocco, Oman, and Pakistan. So, the responsible/ethical AI principles cannot be described as a purely Western construct, even though their development is perhaps disproportionately driven by Western States.

The second problem is that the principles can misconstrue and oversimplify the law. It is attractive and easy to say that humans need to remain responsible and accountable for their use of AI systems. But the way in which criminal law, for example, applies to misconduct in the context of an armed conflict can be quite complicated. There are complex tests about individual criminal responsibility and command responsibility, to say nothing of the procedures for holding people responsible. Therefore, it is not simply a matter of agreeing that humans shall be responsible and accountable. The question is about the circumstances, and the way in which that responsibility and accountability materialise.

Third, the principles can conflate an actual legal obligation, or necessary means for complying with a legal obligation, with what is prudent and practical in certain circumstances. For example, while the traceability of AI processes might not be strictly required in order to comply with any rule of international law, it might be very helpful for ensuring such compliance, and establishing accountability in the case of mishaps.

The fourth issue is that principles also require further granularity to be useful.

Again, it is perfectly sensible to say that a military AI system should be reliable or predictable. But what does that mean? What is the technical standard of reliability or predictability that we expect of a military AI system? Can we apply standards developed in the civilian context or do we need military-specific guidance? Do the standards differ depending on the level of risk that the system poses? Plainly, a lot of important and technically challenging work remains to be done. Thus, even though some States have suggested that language reflecting some of the principles could be incorporated into new legal instruments,[35] that is not necessarily going to get us very far. Some of the principles, reliability being a case in point, are quite general and require further operationalisation.

To end on a positive note, the elaboration of the principles has some important beneficial effects.

- First, these principles help highlight technology-specific problems, which may need technology-specific responses. While the challenge of tracing specific decisions to sources of information and decision-makers is not completely foreign to conventional military technology or operations, the challenge is significantly aggravated by the use of complex systems, including systems that utilise AI. Therefore, the principle of traceability helpfully highlights a problem that needs to be addressed.
- Second, the principles facilitate a multi-stakeholder discussion. French statesman Georges Clemenceau famously observed that war was too serious a matter to be left to soldiers.[36] By the same token, the law is too serious a matter to be left to lawyers. But a public conversation about the law of armed conflict is made more challenging by the complexity of the law. A focus on certain normative principles allows for a broader conversation between military operators, lawyers, ethicists, policymakers, humanitarians, technologists, and so on.
- Third, the principles also focus our minds on the issues that we need to think about and discuss further, because the body of applicable law is vast. In other words, the principles provide us with something of an agenda for developing governance.

In conclusion, considering and building upon principles of ethical or responsible use of military AI is a worthwhile activity. But such principles are certainly not a silver bullet—they cannot replace existing law or potential future law.

NOTES

1 On the latter point, see Paul Lushenko and Keith Carte, 'A New Military-industrial Complex: How Tech Bros Are Hyping AI's Role in War', *Bulletin of the Atomic Scientists*, 7 October 2024, at https://thebulletin.org/2024/10/a-new-military-industrial-complex-how-tech-bros-are-hyping-ais-role-in-war/.

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3 Adib Rashid, Ashfakul Kausik, Ahamed Sunny and Mehedy Bappy, 'Artificial Intelligence in the Military: An Overview of the Capabilities, Applications, and Challenges', *International Journal of Intelligent Systems*, Article 8676366, 2023, at https://doi.org/10.1155/2023/8676366.

4 Angela Sheffield, quoted in Adam Stone, 'Practical Applications for AI in Military Operations', *Air & Space Forces Magazine*, 7 October 2024, at https://www.airandspaceforces.com/practical-applications-for-ai-in-military-operations/.

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12

Autonomous Robotic Systems in the Transformation of Modern Warfare

Artsrun Hovhannisyan

The Military-scientific Transformation of Modern Warfare: Theoretical Justifications

In the USA in 2022-2024, the 'MDO/JADO' concept, and the issues of the composition and armament of their respective military units and military groups are widely discussed and tested in practice.[1] Specialists are relying more and more on self-sufficient and independent units, on simultaneously conducting operations in all domains, on eliminating the separation of offensive and defensive weapons, on autonomous robotic platforms, and even artillery.[2] This concept defines simultaneous supremacy in air, sea, space, cyberspace, and especially cooperation and integration in these domains. This level of development makes it possible to move from hitting the enemy's usual targets to the effect of 'results.'[3] However, the main thing has always been, and remains, the person, the soldier, who must be able to think and act without fail at the same speed. In 2020, the units of the 'Tnufa' program underwent tests in Israel.[4] Unlike the American version, this program is called 'multi-dimensional',[5] which means multi-dimensional when literally translated, but in meaning it is the same American multi-domain. His ideas are very clear, and largely repeat American conceptual approaches, where the units called 'Ghost Units', and are endowed with the ability to conduct operations in all dimensions at the same time.[6]

These are essentially the battalion-brigades of the American 'MDO/JADO' concept, with certain localizations. Back in 2019–2020, the theory of NPC (network-platform-centric) wars was put forward in theoretical discussions, which is essentially the preservation of the principles of these concepts, with certain differences.[7] In 2019, US Army Lieutenant General, David Deptula, together with several authors, proposed the Mosaic Warfare theory, in parallel with the NPC theory, as part of a post-liberation study commissioned by DARPA.[8] Deptula focused on cyberwars in his theory. According to him, network elements working with mosaic can operate very quickly and effectively in the cyber domain, independently of each other and complementing each other. As he repeated, his theory is the 'MDO' concept, but faster.[9] In 2019–2023, DARPA presented the concept of 'All Domain Mosaic Warfare'[10] wars in various exhibitions, which is actually one of the developments of the 'MDO' concept; it is more large-scale and more related to air defence systems.[11]

Multi-layered/Complex Wars

Summarizing all this, this essay puts forward the concept of a new, sixth-generation war, which may be called multi-layered/complex wars. This concept is a set of actions conducted separately or together. This warfare includes and integrates cyber, hybrid, information, psychological and other environments. Now, we have a new understanding of Cybrid. This is regular and irregular wars, together and all inclusive. These actions can be in three or four physical environments: in the cyber environment and the information-psychological environment, which today is also called the 'cognitive' environment.[12] The processes conducted separately from each other, and sometimes the influence of soft power, ideological and persuasive mutilations, and subtle military interventions—which are called 'hybrid' today—are added to the large-scale combat operations of regular troops, and pike of irregular groups. All these actions will become routine. The simultaneous process of all these actions is complex and multi-layered; the planning, implementation, and constant management of which will require great efforts and skills. They will demand a different quality of commanders.

First Glimpses of New Complex/Multi-layered Warfare

Starting from the beginning, the Russian-Ukrainian war was conducted more by the standards of the fourth generation; the sides had small tools of fifth generation warfare. However, with the emergence of some western technologies and the prolongation of the war, the parties began to apply new solutions and technologies,

which are related to the rules of future complex/multilayered wars. The Ukrainian Armed Forces inflicted painful blows on the Russian fleet in the Black Sea with autonomous robotic systems, effectively gaining maritime supremacy. They are also inflicting painful pinpoint strikes on Russian military bases with UASs. Last week they conducted strikes against the Russian ships in the Caspian Sea. Within the framework of my personal research, I have found out that, as of mid-May 2024, the Ukrainian army used up to 150 units of two types of such striking means per day in the tactical ring. Frontline combat brigades use a minimum of 1,200 FPV drones per month. According to eyewitnesses, the 3rd Assault Brigade used 5,000–8,000 different types of UASs in a month during intensive combat operations. The Ukrainian experience in the development of this type of striking means is considered unprecedented. Moreover, as of 2024, the Ukrainian 'FPV' drones are also opening a new page of their use, using certain technologies of artificial intelligence as a means of hitting large UASs—that is, as fighter drones[13] as means of combating helicopters in the air, etc. The Ukrainian UASs have not only become destroyers of other UASs, but also following the Russian UASs, they reach the launch point and direct the Ukrainian artillery fire at that point, destroying the launch stations and crews.

The attack of August 6, 2024, by which the Ukrainian Armed Forces invaded Russian territory, opened many military-scientific innovations. This operation can be considered the first military operation that was planned and implemented according to the 'MDO' concept. Months ago, the Russian volunteers fighting in the Ukrainian army, were testing the strength and weak points of the Russian defence with sabotage. The strong and weak points of the Russian army were studied by all forms of intelligence—the operation of Russian radio stations, radio systems, jamming systems and REW (Radio-electronic warfare) capabilities, frequency of UASs and control networks, etc.[14] were analysed in detail. The Russian REW forces and means had caused big problems for the Ukrainian side in the previous year.

Here, it is important to mention the fact that, during the planning stage of this strategic operation, when the Ukrainian specialists were finding the weak points of the Russian systems, cybrid and cognitive operations continued, by which they convinced the world that the Russian side is almost unbeatable in this matter, and that the Western precision weapons have problems because of the Russian Jamming systems and REW, and so on. It is not that this was fake; but the achievements of Western specialists and technologies in the matter were well hidden, and created the impression that the Russian armed forces are invincible.

This is a great example of a fallacy, a cognitive effect. And, the Ukrainian measures actually caused serious problems for the Russian Jamming systems and REW.[15]

The Ukrainian side planned everything secretly and covertly, and used the problem of the lack of resources of the Russian army. General Sirsky implemented yet another ingenious informational cover for the secret military movement of his troops. A couple of months ago, there were rumours that the Russian army was going to attack in the direction of Summi (like Kharkiv), therefore it was necessary to strengthen the borders of those areas. Under that pretext, little by little troops were moved in that direction. However, even the Ukrainian troops did not know that they were being prepared for an attack.[16] The intelligence knew very well that the Russian army had reserve problems, and that the borders in the other sectors, except for the Donbas direction, were bare, to say the least, in terms of forces and means.[17]

During the planning of the military operation, great attention was paid to the harmonization of the attacking forces, groups, and military units. The operations were, by their very nature, complex and fast. And despite this, the enemy managed to understand the preparation. The Russian command had noticed the movement of the UASs battalion of the 22nd mechanized brigade of the Ukrainian Armed Forces, as well as the regroupings of the forces of the 80th and 82nd airborne brigades.[18] However, as often happens, after these movements, no appropriate conclusion was arrived at, and/or no decision was made. These experienced Ukrainian troops were pulled out of the toughest spots in time.[19] Using Jamming systems, REW, and air-defence means, the Ukrainian troops perfectly harmonized them with the UASs, which worked in swarms and, by attacking, they even hit Russian helicopters.[20] The Jamming systems and REW means had suppressed the Russian communication and control systems, the UASs, etc.[21] In other words, complex and precise operations were carried out. The ground forces that invaded the Kursk region included both regular troops and high-ranking troops, as well as territorial defence forces. The tactics of operations are essentially a combination of subversive quick operations, the classic attacks of regular troops, and irregular tactics. Some units of the ground troops used ground robotic systems, including robotic dogs. And, one of the small combat robots has become a 'hero,' because the Russian subdivisions tried to hit this system 16 times. However, the latter performed its combat task, and returned.

Although slowly, but the ground robots, and autonomous systems are finding their permanent place in the concepts of future wars. With all this, they ensured a high level of joint power harmony.[22] The first brigades developed the attack

with relatively light American and Western armoured vehicles in order to be able to ensure the high pace.[23] Heavy armoured vehicles came in the second column. During combat operations, the Ukrainian troops reached such a level of harmonization that they use cluster artillery shells during defensive battles of their own troops without harming their own troops. Armoured vehicles are used in the company of their own accompanying fighter 'FPV' drones, which hit the enemy's similar strike means, helicopters in the air, and protect their own armoured vehicles. All this is a manifestation of the 'MDO' concept, which we have seen in the real battlefield for the first time.

Conclusion

If aerial drone systems have nothing to prove in terms of their effectiveness and perspective, and marine systems are already developing at a high pace, then land robotic systems are relatively new in military affairs. They are still just settling their place and role, but they also have a great perspective. Autonomous ground robotic systems can change the nature of ground combat, allowing it to operate faster and with less loss of life. These concepts still need to be refined and developed, but they also have a great future. According to the information published by the Ministry of Defence of Ukraine, the Ukrainians managed to reduce the losses of the armed forces by about 30 percent due to the use of robotic systems.[24]

Land robots will soon be of an extremely large number and variety. They will solve various combat and security problems. In the future war, one of the issues on the agenda will be the integration of robotic systems of all dimensions, and the clear determination of the role of man in that matter. This is where the role of various automated management systems and artificial intelligence becomes important. Unfortunately, we also saw this in the 44-day war in Artsakh.[25] We see that in the Ukrainian war, 'Combined Joint All-Domain Command and Control (CJADC2)', and similar systems, are undergoing great development.[26] Of course, they are not ideal, and the troops often complain about the efficiency of their work, but they have a great perspective.

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13

The Evolving Landscape of Air and Missile Threat: A Defender's Perspective

Uzi Rubin

Introduction

Today's landscape of air and missile threats is fast evolving into an ever-increasing complexity. What barely one generation ago was a coherent and well definable threat from crewed aircraft and Keplerian trajectory ballistic missiles has now evolved into to the full spectrum of threats—from low cost but deadly Rotary Wing Drones to cheap cruise missiles, and then all the way to hypersonic, atmospheric skipping ballistic missiles that follow non Keplerian trajectories. Moreover—and contrary to Carl von Clausewitz's hypothesis that 'defence is the stronger form of war'—in the case of air and missile defence, the opposite is generally true. In the overwhelming majority of cases, the cost of defending against any particular air and missile threat is higher than the cost of the threat itself. In the past, the expenditure of a million-dollar interceptor to down a multi-million-dollar combat aircraft was well justified. Today, to shoot a million-dollar interceptor against a propeller driven suicide UAV that costs less than one tenth of that of the interceptor is a losing prospect.

The purpose of this essay is to chart the evolution of the threat landscape, from its legacy configuration as it was about one generation ego, to its present, complex and almost chaotic configuration today. The essay will chart the evolution of the legacy of the threat landscape from its early emergence more than one

century ago, to the present-day landscape which is rapidly becoming more complex, impelled by the two current wars in Ukraine and the Middle East.

The main body of this essay consists of two parts. The first one describes the evolution of the air and missile threat landscape from its early days to its legacy landscape of the first decade of the current century. The second part describes the disruption of the legacy air threat landscape at the present era. Finally, some conclusions will be derived and some predictions will be offered about the technologies and strategies that may help to overcome some, if not all, of the new threat landscape complexities.

The Emergence and Evolution of Air Threats

From the dawn of civilization until the second half of the 19th century, armed conflicts took place on the earth's surface. Armies moved and fought on the land surface, and navies clashed on the surface of bodies of water: lakes, rivers, seas, and oceans. Wars were fought in two dimensions as long as the technologies for conquering the third dimension (that is, flying machines) were lacking. Fighting above or below the surface was a matter of mythology, or later, of lone pioneers and science fiction authors. The ancient Greeks told the legend of Pegasus, a winged horse, carrying the hero Belerophone through the air to attack and kill the monster chimera. Human flight was envisaged by the Greeks in the legend of Icarus and Daedalus, escaping the island of Crete with the aid of artificial wings, crafted from feathers and beeswax. Unfortunately, Daedalus flew too high, and the heat from the sun melted his wings, causing him to crash into the Mediterranean Sea.[1]

Over the ensuing eons, countless inventors and entrepreneurs failed again and again to devise the means for human flight, or to devise flying machines. The most serious effort occurred in the 15th century, when Leonardo Da Vinci outlined several types of human powered flying machines, both of the fixed wing and rotary wing types. Today, the general consensus is that the Da Vinci designs would not have worked due to the poor power to weight ratio.[2]

Surprisingly, first practical human flight came not from emulating the flight of birds, but from aerostatics. The first practical flying machine was the hot air balloon, invented and demonstrated by the French brothers Montgolfier in June 1783. The military value of this invention for battlefield reconnaissance was quickly proved in the French revolutionary wars, when manned observation balloons turned the tides of battles.[3] Military observation balloons were used to significant

effect during the American Civil War (1861–1865) and the First World War (1914–1918). Overshadowed by the invention of the aircraft, they were used as static obstacles against aircraft ('barrage balloons') during the Second World War (1939–1945). Today, unscrewed balloons continue to serve for surveillance and reconnaissance, mostly as static observation posts; and, in some cases, as free flying platforms for strategic spying missions.[4] However, due their usually limited use and mostly static missions, balloons are not counted as air threats.

War moved into the third dimension when the first true air threats in history materialized. These were the outgrowth of the free flying balloons: the dirigible (that is, steerable) balloons—'airships' or, in the more popular term, 'Zeppelins'. Zeppelins were powered, lighter than air, and fairly large aircraft, capable of carrying a significant load of bombs (or alternatively, of passengers) to continental and oceanic ranges. The first practical airship flew in the last decade of the 19th century. By the first decade of the 20th century, they were already used as passenger airliners in Germany. With the onset of the First World War, they were converted into bombers, being used between 1915 and 1917, to bomb London and other towns in the UK. However, these weapons proved to be very susceptible to the hastily devised air defences of the UK, and they were withdrawn from service fairly soon.

The heavier than air aircraft, invented in 1903, proved to be more viable than the lighter than air machines. First used to bomb ground targets in the Italian-Turkish war of 1912, they quickly evolved into reconnaissance, fighting, and bombing types. Once the German Zeppelins were withdrawn from the skies of Britain, they were replaced by German multi-engine bombing aircraft. The German bombing campaign against the UK in World War I prompted the creation of the first integrated air defence system in the world, consisting of early warning, battle management, and interception segments, designed to defend London against air attacks.[5]

Air warfare, pitting manned aircraft against land and naval air defences, featured prominently in World War II, which saw the intensive use of tactical air power against ground forces, and of strategic air power to destroy cities, industries, and critical economic infrastructure. By the end of that war, the dominant air threat was that of the fast evolving and ever more capable manned aircraft, against which ever more complex air defence methods were being devised, maturing from anti-aircraft artillery into ground to air missiles. The early Cold War saw a continuation of this race between air offense and air defence. Perhaps its culmination was the US homeland air defence system, designed to defend against

hypothetical intercontinental Soviet nuclear crewed bombers. This included the complex early warning system—The Distant Early Warning (DEW) line—made up of squadrons of short-range interceptors such as the F 102, and cutting edge, nuclear tipped, interceptor missiles such as the CM10 Bomark. Developed, manufactured, and deployed at the cost of billions of dollars, this system was dismantled after the emergence of the intercontinental ballistic missile threat as the main threat to the USA.[6]

Thus, the more effective air threats begat effective air defence which, in turn, compelled the emergence of the ballistic missile threats. The steep trajectory and high speed of ballistic missiles made them immune to air defences. This encouraged Germany to develop the first ballistic missile ever, and to deploy it against Britain in the closing phases of World War II. While unsuccessful in preventing Germany's defeat, the German V2 missile caused severe losses and damage in London and other European cities. The potential of merging the newly developed nuclear weapons with ever larger ballistic missiles was obvious as soon as the War was over, and both superpowers launched development programs of nuclear tipped intercontinental ballistic missiles (ICBMs).

The first to reach the mark was the Soviet Union, with its giant R7 Semyorka's first successful test in August 1957. The USA was a close second, with the first successful test of the SM65 Atlas in September of that year. The following years saw massive deployments of ICBMs by both superpowers, and even lesser powers such as France. The ICBM assumed the status of the kingpin of national security of both sides, based on the premise of 'Mutual Assured Deterrence' (MAD, misquoted by the media as 'mutual assured destruction'). Simply put, the general view was that ballistic missiles 'could not be defended against'. Hence the only way to prevent a nuclear Armageddon was to threaten the other side by a missile born nuclear holocaust.

Nevertheless, the ascent of the nuclear tipped ballistic missile generated efforts on both sides to search for defensive weapons that could intercept and destroy them while in flight. The effort of both superpowers was aimed at upgrading the anti-aircraft missile systems so that they could tackle the steep trajectory and high speeds of ICBMs. Once again, it was the Soviet Union that achieved the first interception of a ballistic missile in March 1961.[7] The USA achieved the same feat a year and a half later, on December 1962.[8] Both superpowers developed anti ICBM systems. However, the rapidly evolving threats and the immense cost of production resulted in limited deployment. It also led to the Anti-Ballistic Missile

(ABM) treaty which, while in force, froze the advancement of missile defence systems on both sides.

However, the emergence of non-nuclear tactical and theatre range ballistic missiles in the 1970s, and their first use in wars (The Iran-Iraq war of the 1980s) caused the rapid development and deployment of non-nuclear ballistic missile defence systems, both surface based and sea based, in numerous countries such as France, China, India, and Israel. Their effectiveness was demonstrated in the various conflicts of the current century. On the whole, ballistic missile threats begat effective ballistic missile defences—at least in the case of conventional threats.

After manned aircraft and ballistic missiles, the third kind of air threat to emerge was the cruise missile.[9] While primitive Cruise Missiles (dubbed at the time 'Flying Bombs') were already used by Germany during the later phases of World War II, it was the perfection of two new technologies[10] that led to the development and deployment of the first true cruise missiles during the 1970s. From the defender's point of view, a cruise missile was nothing but low flying aircraft, albeit an unscrewed one. Yet, their map of earth flight profile—flying low and using terrain features to hide from early warning radars—turned them into a class of threat all their own. At the time when the first conventional ballistic missile defences were being developed in the1980s and 1990s, the question whether they should be designed to deal with both ballistic missiles and cruise missiles, or whether they should deal with each kind of threat separately, was in high debate. In practice, most missile defences designed against the high end of the conventional missile threat (such as the theatre or medium range ballistic missiles) are dedicated against ballistic missiles, while those designed against the lower end of ballistic threats (such as rockets and short-range ballistic missiles) are capable of downing cruise missiles.

A fourth kind of air threat matured in the early 1980s: the modern Uncrewed Air Vehicle (UAV). While the simple UAV has already been used for various tasks in the first half of the 20th Century, a newer generation emerged in the early 1980s. In essence, it consisted of small fixed wing aircraft, propelled by piston engines and using satellite navigation. Initially, they were used exclusively for real time reconnaissance. Unlike the earlier jet-propelled reconnaissance drones that brought back exposed films that had to be developed and interpreted, the new generation of UAVs used communication links to transmit back real time images of their targets. Their small size and radar absorbing, composite material structures made them stealthy, and eluding radar detection. Hence, they were difficult to

locate and destroy by the than extant air defence systems. They could loiter above the terrain below, and provide instant view of enemy positions and movements.

The Legacy Air Threat

The four kind of air threats—combat aircraft, ballistic missiles, cruise missiles, and the modern UAV—comprised the air threat landscape of the early 21st century. Each one of the four kinds operated within a unique envelope, which was relatively easy to define. This allowed for the devising of either generalized or specific defensive systems, or tactics. For example, the first appearance of cruise missiles ('flying bombs') in World War II caused the UK to devise the specific tactic of 'belted' defence—belts of air-to-air interceptions alternating with belts of ground-based interceptions (anti-aircraft artillery). Largely, this did not involve any new defensive technology.[11] The concurrently deployed ballistic missiles—the German V2—remained unchallenged during that War, and for several decades later. It was only from the 1960's onwards that interception technologies became feasible. Once this was mastered, the major powers chose between specialized defence systems (air defence or missile defence) and generalized systems ('extended air defence'—that is, systems that could deal both with horizontally flying air breathing threats, and steep, plunging trajectories of ballistic threat). One good example is the US Patriot Air Defence System.

Developed in the 1970s as an air defence system, it was upgraded in the mid-1980s to deal with the theatre ballistic missile. The new version, dubbed PAC 2 (Patriot Air Capability 2), was initially unsuccessful. But later, when its teething problems were solved, showed its capability against ballistic threats in Iraq (2003), and later, against both theatre ballistic missiles and UAVs in Saudi Arabia (2015–2022). Its newer version—the PAC 3—is currently scoring successes in Ukraine against Russian cruise and ballistic missiles. It achieved its first operational success against a crewed aircraft in 2014.

In all, the now venerable Patriot system, and its versions, have demonstrated the capability to intercept and destroy each of the four kinds of air threats that comprise the legacy threat landscape—crewed combat aircraft, ballistic missiles, cruise missiles, and UAVs. It may well be that Russia's S 300 system, designed from the start as an extended air defence system, might have similar capabilities.

Success and Disruption

Once deployed, all three variants of ground-based defences against air threats have proved effective. The Soviet Ground Based Air Defence (GBAD) systems,

such as the SA 2, SA 3, SA 5, and SA 6 proved highly effective (and very costly to air power) in the skies of South East Asia (the Vietnam war) and in the Middle East (The 1973 October War). Missile defence against short range rockets proved its effectiveness (Israel's Iron Dome) in numerous engagements since 2011. The US Patriot system shot down crewed aircraft, UAVs, and cruise missiles during the Saudi-Houthi war (2015–2022), and in Israel.

Yet, the arms race in the modern era, driven by ever accelerating rate of technical innovations, never stops. The very success of the defences against the 'legacy' threats of manned aircraft, ballistic missiles, cruise missiles, and UAVs have triggered a flood of innovations, designed to disrupt the effectiveness of air and missile defences. The core requirement for intercepting any air breathing target is detection and tracking. For ballistic targets, there is a second core requirement: the prediction of its trajectory and aim point. A third core requirement common to all kinds of defences is that of capacity. Each and every defence system has a definite capacity to deal with a finite number of threats.

Disruption, then, can be effected either by decreasing target detectability, or by decreasing target predictability, or by increasing the number of threats beyond the defensive system's capacity (that is, saturation), or by a combination of all three.

One way of reducing detectability is by using stealth technologies. This route has led to the modern, 5th generation stealth crewed aircraft, like the US F 22 and the F 35, as well as the Russia's Su–57 and China's J–20. Since this essay is oriented towards uncrewed air threats, it will not further elaborate on Stealth type of disruption. Another way of reducing detectability is by following covert flight paths that are below the horizons of early warning and detection radars, or electro optical devices. If most of the flight path is covert, late detection and tracking might not leave sufficient time for effective interception. A third way to reduce detectability is by using small size—hence low radar cross section—air threats. Coupling this with low speeds that may be typical to natural phenomenon (such as the flight of birds) further complicates and confuses the defender's detection and discrimination process.

As for disrupting predictability: this can be achieved by following non ballistic trajectories. While non ballistic trajectories are the inherent property of air breathing threats, it is less easy to achieve in rocket powered threats. Yet, it can be implemented even for rocket threats by following a flight path that lies within the atmosphere, using aerodynamic forces to shape non ballistic trajectories. This will be expanded upon further in this essay.

Finally, and as noted above, any defensive system can be overwhelmed by saturation. This kind of disruption bears a strong affinity to battlefield economics. It stands to reason that the complex, expensive threats will be deployed in limited numbers, making saturation too expensive for the aggressor. The route to affordable saturation goes, therefore, through low cost, mass-produced air threats. Again, this will be expanded upon further in this essay.[12]

Translated into a real-world threat system, one can distinguish three families of disruptor threats: Hypersonic missiles, combat UAVs, and Rotary Wing Drones. Each of these disruptor families will now be discussed.

Disruptor: Hypersonic Threats

The term 'Hypersonic speed' denotes speeds of 5 times and higher than the speed of sound in the air (in scientific terms: Mach 5 and above). Until a couple of decades ago, there was no air breathing aircraft that could reach such speeds. However, ballistic missiles, with ranges of about 1000 kms and above, have been re-entering the atmosphere at hypersonic speeds. Legacy missile defence systems are designed to intercept even such fast-flying threats, provided there are timely early warning and predictable trajectories.

Thus, while dealing with threats that travel at hypersonic speeds is part and parcel of the legacy missile defence system, the new generation of hypersonic threats are designed to disrupt it mainly by disrupting predictability, or by curtailing the time duration between detection and impact. New generation hypersonic threats come in three kinds.

- *Aero ballistic hypersonic missiles.* These are ballistic missiles that fly minimum energy trajectories (that is, classical parabolic Keplerian trajectories), but which, once they re-enter the atmosphere at hypersonic speeds, perform violent and unpredictable manoeuvers that do not permit interception point prediction. The Russian Kinzhale, unveiled by Russia's president Putin in March 2019, was a prime example of this kind of hypersonic weapon, advertised as being immune to existing missile defence systems.[13]It should be noted that when actually used in combat during the ongoing Russia Ukraine war, the Kinzhal was revealed to have less immunity to missile defence than advertised by Putin, being often intercepted by the advanced versions of the US Patriot system.[14]
- *Hypersonic Glide Vehicles*. Ballistic missiles with ranges beyond 300 Km usually have a detachable front section, termed 'Re-entry Vehicle' (RV)

which contains the missile's payload ('warhead'). A detachable RV is necessary because the aerodynamic loads on the missile during re-entry could break it apart, thus degrading its accuracy to unacceptable levels.[15]
In legacy ballistic missiles, the re-entering RV is designed to cut through the atmosphere in the shortest route to the target. However, the high dynamic pressure during re-entry can be used to extend the range of the weapon system by causing the RV to glide at hypersonic speeds. To do so, the RV is equipped with control surfaces and its own guidance system. In some cases, the RV is given an asymmetric wedge shape, to increase its lift coefficient. The RV is, thus, turned into a hypersonic glide vehicle (HGV).[16]
Ballistic missiles with HGVs are programmed to fly in lofted trajectory, with the -nominal aim point being short of the target. Upon re-entry, the HGV performs an insertion manoeuvers which position it horizontally in the direction of the flight, with a small angle of attack. It then follows a quasi stable glide trajectory, steadily trading altitude for speed, to compensate for the energy losses due to drag forces. During its glide phase, the HGV can perform some mild horizontal manoeuvers, including a steady turn. The flight can be terminated at any point selected by the aggressor.
The use of HGV deprives the defender from any capability to predict both the threat's trajectory as well as what it is targeting. Since it travels relatively low (that is, relative to classic ballistic missiles, with their high apogee minimum energy trajectories), it can stop the glide, and dive on any target along its projected path. HGVs lose their stability at around Mach 5; but this does not mean that predicting its position when its speed decays to Mach 5 will reveal the intended target. The HGV can be programmed to terminate its flight, and dive at any point ahead of the minimum speed limit. As far as is known, no extant missile defence system is effective against this type of threat.
Ballistic missiles with HGVs are now deployed by Russia, China, and North Korea. The USA has several HGV based missiles in development, which may become operational later on during the current decade. India and Iran have announced HGV programmes of their own.

- *Hypersonic Cruise Missiles.* Unlike ballistic missiles, cruise missile (CM) use air breathing propulsion. Earlier, subsonic CMs used turbojet and fanjet propulsion. Supersonic cruise missile, like India's Brahmos, use ramjets to cruise at Mach 3 speeds. The relatively new technology of

Scramjet—ramjets that burn their fuel at supersonic speeds—allows the achievement of hypersonic speeds with cruise missiles.

Russia was the first country to deploy an operational Hypersonic Cruise Missile (HCM), the 3M22 Zyrkon. Cruising at speeds of up to Mach 9 (about 3 Km per second) and an altitude of about 30 Km, the time between detection and impact is very short, making it difficult to mount an effective defence. Like all other freely manoeuvering cruise missiles, its trajectory is unpredictable. According to Ukrainian sources, Zirkons were used by Russia for urban attacks[17]

Disruptor: Combat UAVs

As described above, UAVs have already constituted a part of the threat landscape of the 1980s and 1990s. However, at that time the overwhelming majority were used for reconnaissance, with optical sensors (telescopic cameras) as the main payloads. By the turn of the century, more and more UAVs turned into combat machines, in two different ways.

- Attack UAVs were created by installing hard points for wing carried munitions—in most cases, precision glide bombs and missiles. Most attack UAVs are multi use, expensive machines, operated from runways. They have the size of small aircraft, and although constructed from composite material, carry enough metal to be detectable by modern air defence radars.[18]
- Suicide UAVs, in contrast, do not carry outside store, but contain built in warheads within their fuselages. They are simple, single use machines, yet accurate enough to hit with pinpoint precision. Being disposable, they are by necessity quite cheap to make, and are deployed in very large numbers. Being one-way weapons, they usually lack landing gears and are launched from catapults, or boosted to flight speeds by rocket assist. Suicide UAVs are, in fact, a kind of cruise missiles—that is, one way point to point expendable weapons. The main difference between them and 'classic' cruise missiles is that they are powered by piston engine turning propellers, hence quite slow. Newer versions of suicide UAVs are equipped with toy jet engines. In the simplifying argot of the media, such jet powered suicide UAVs is dubbed a 'cruise missile'.

From the defender's perspective, the large attack UAVs are basically large, slow flying aircraft that may be even easier to engage than fast, high flying crewed combat aircraft. Ukraine's vaunted fleet of Bayractar TB2 attack UAVs was quickly

decimated at the very beginning of the Russian-Ukraine war by Russia's very capable GBAD.[19]

It is the Suicide UAV—or in a current parlance, 'one way attack drones' (OWAD)—that are challenging air defences today, as has been demonstrated recently in the Houthi-Saudi war, in the second Nagorno Karabagh war, in Ukraine, and in the Gaza war. The challenge comes from their small size, nap of earth flight profiles and—in some cases—extreme ranges. Another factor that amplifies their impact is their low cost. Most OWADS are small and simple machines, which achieve precision accuracy by utilizing commercial grade, arms control restriction free avionics. Their low cost allows their operator to produce them in huge quantities, and use them *en masse* against their targets, saturating whatever defences are deployed, whether air based or ground based.

OWADs first became famous when Iran launched swarms of them against two key Saudi Arabian oil installations in September 2019. Launched from a distance of about 700 km, the Iranian OWADs hit with pinpoint precision, reducing Saudi oil processing capacity by one half for several months. In essence, an OWAD is a smaller, simpler, and cheaper variant of the classic cruise missile.

As difficult as it is to defend against classic cruise missiles, the challenge of the OWAD is even higher. OWADs tend to be small (the wingspan of the Russian Geran 2—a license produced version of the Iranian Shahed 136 is just 2 meters). The small size, composite material structures map of the earth flight path and slow speed makes detecting them in time and shooting them down extra difficult. Geran 2 OWADs are being used in thousands by Russia against Ukraine infrastructures.[20] The Ukrainians, after more than two years of trial and error in trying various schemes of defence against them, are still incapable of shooting down more than about 80% of them by air interception, combined with ground anti-aircraft fire.[21] The 20% or so of Geran 2s that leak through the defence are lethal enough to cause a steady erosion of Ukraine's electricity network.[22]

On a smaller physical scale but having a larger impact on the battlefield are the rapidly evolving small OWADs and loitering munitions. Small, electrically powered, optical sensor equipped drones, with small warheads but with pinpoint precision, are currently taking out tanks, air defence systems, and other key military facilities in the battlefields of Ukraine and the Middle East. The Russian 'Lancet' and the US 'Switchblade' are prime example of such weapons. Both are, in essence, small winged, electrically propelled uncrewed aircraft. Their latest versions are reputed to have AI based automatic target recognition software. Their low cost of

production makes them so prevalent that shooting them down one by one is close to an act of futility, from both the operational and economic aspects. Accordingly, the defenders on both sides are striving to neutralize them by Electronic Warfare (EW), and by passive defences (such as encasing the potential targets with steel mesh).

Disruptor: Rotary Wing Drones (RWD)

Rotary Wing Drones first appeared in the early 2000's as recreational devices and children's toys in the format of quadcopters. By 2005, they were already equipped with commercial grade inertial guidance systems, satellite navigation sets, and cameras. This made them attractive to military users for battlefield reconnaissance. Making them slightly overpowered, they were allowed to carry payloads such as bombs, RPG rockets, and similar light but lethal weapons. Using the built-in cameras, the operator could hit targets below with pinpoint precision. A later development was the First Person View (FPV) RWD that combines high speed with forward looking cameras. This allows their operators to use them as guided weapons with unprecedented precision, capable of (among other things) disabling armoured fighting vehicles, and even low flying helicopters. Yet, being evolved from the consumer product industry, their cost is a fraction of that of conventional, military grade precision guided munitions (PGM).

The Russian Ukrainian War has leveraged the use of RWD to hardly imaginable levels. Being fairly easy to design and produce, and requiring only modest capital investment in industrializing their production lines, they have been massively deployed by Ukraine's armed forces after the Russian invasion of 2022. This was later emulated by Russia's armed forces.

One of the impacts of the mass use of RWD is making the battlefield transparent. The thousands of RWDs constantly loitering over Ukraine's battlefields provides persistent optical, thermal, and electronic surveillance that detects troops and vehicles, and even tracks the motion of individual persons. This makes it difficult to hide military forces concentrated for offensive actions. Another impact is their effectiveness as low cost, highly accurate PNGs. According to media reports, in one week, Ukrainian FPV drones destroyed 75 Russian tanks as well as 101 artillery pieces. Ukraine plans to produce between 1 and 2 million RWDs during the current year of 2024.[23]

While PNGs are not new, The RWDs are unique in combining precision with rock bottom cost. Their affordability means that they can be produced and

used by the millions. For the defender, this is a hardly solvable conundrum. The more you shoot them down, the more they come.

While technologies and commercial systems to shoot down or capture RWDs have already existed since some years ago, the available counter RWD systems are optimized to deal with small number of threats used by civilian amateurs (to disrupt airport traffic), criminal operations (such as smuggling contraband into prisons) and terrorists.[24] RWDs can be shot down by rifles with special gun sights, or even by shotguns.[25] However, the huge number of RWDs that are inundating the battlefields of Ukraine renders killing them one by one quite ineffective. The more effective way of combating swarms of RWDs is disrupting their communication with their operators by electronic warfare (EW). EW is extensively used both by Ukraine and Russian in their attempt to block each other's RWDs. The problem with this method is that most EW systems have a limited span of frequencies that it can jam. RWD operators can shift to less used frequencies. This leads to a cat and mouse technological rat races on the front line, where aggressors and defenders constantly hop from jammed to clear frequencies, only to have them jammed too. This Darwinian like contest between measures and countermeasures is going on at the time of writing. The future introduction of Artificial Intelligence (AI) to the RWD can enable them to acquire and destroy the targets, with no need for jammable communication links.[26] If and when implemented, AI equipped RWDs may become weapons that cannot be defended against.

Characteristics of the New Threat Landscape

As described above, the legacy landscape featured distinct 'Peaks', or cluster of threats that have similar features—the manned aircraft cluster, the ballistic weapons cluster, the cruise missile cluster, and the unarmed UAV cluster. Each could be dealt with by specialized families of defences, designed to defeat the narrow band of each cluster's characteristics. This is no longer true in the new threat landscape.

The former clusters now merge into each other almost seamlessly. What was a classic ballistic missile is now a potential carrier of a Hypersonic Glide Vehicle which, if equipped with an air breathing scramjet, can turn into a Hypersonic Cruise Missiles. The suicide UAV—or in the more recent parlance, the One-Way Attack Drone (OWAD)—is essentially a slow flying (and cheap) cruise missile. The Medium Altitude Long Endurance (MALE) UAV is, from the point of view of the defender, not much different than a slow flying, low-cost manned aircraft.

The RWD can be regarded as the slowest but cheapest kind of OWAD; yet its miniscule cost and ease of manufacturing makes it a class of its own.

What stand out in the new Air Threat Landscape is the ever-decreasing cost of offense against an ever-growing cost of the defence. Today, battlefield economics are trending in favour of the offense. This is not new: the 'Cost Effectiveness at the Margin (CEAM)'—that is, the ratio between the cost of one unit of offense and the cost of one unit of defence—has been favouring the defender only in the case of the manned aircraft threat, where even expensive ground to air, or air to air missiles were almost always cheaper than the multimillion dollars combat aircraft they targeted. However, in the case of uncrewed air threats from ballistic missiles to RWD, the CEAN has always been favourable to the aggressor. And, the new threat landscape makes the CEAM even more so. In some cases, defence—even if feasible—becomes unaffordable. Consequently, defence is now lagging behind offense.

The Road Ahead

The two main challenges of defence in the new threat landscape are: first, to reinstate detectability and predictability in the face of ever more evasive and ever lower RCS targets; and second, how to reinstate battlefield economics back to affordability.

There is no doubt that new technologies and defence architectures will be required to meet these two challenges. What the new technologies will encompass is still unknown. Yet, some outlines can be hazily discerned today. Detection and tracking were mainly performed by radars since World War II. Future technologies, such as persistent space surveillance, might complement, and even replace radars, in the case of low flying, evasive trajectory threats. Over the horizon radars show some promise to become sufficiently advanced to provide precise tracking beyond the curve of the earth for low flying threats. Acoustic detection and tracking are already being practiced in the Ukraine war.

As for retrieving an acceptable level of affordability, low-cost methods of killing air threats should be sought out, and perfected. Laser weapons offer very low costs per kill; yet they suffer from weather limitations and, at this time, are still very expensive, and almost too complex for field use. Microwave weapons too promise low costs per kill, and are not affected by the weather.

What is invented by one human can be counter-invented by another human. This truism has held good throughout the history of human conflict. There is

now doubt that the new, disruptive threat will eventually be effectively countered. How and when this will be achieved, remains to be seen.

NOTES

1 While third dimension warfare below land and water surfaces is quite significant (e.g. submarine warfare) this aspect of war is beyond the scope of this paper.

2 Human powered flight was finally achieved in the 20th century, when lightweight structural materials became available. Yet, its application is limited to academic prestige and bravura rather than to any practical purpose.

3 The first recorded use of a manned observation balloon is the Battle of Fleurus, June 1794, which helped the French revolutionary army to win it.

4 The most recent case of balloon spying was the flight of a Chinese giant balloon over the USA in January-February 2023. See, Youssef, Nancy A. (June 29, 2023), 'Chinese Balloon Used American Tech to Spy on Americans', *The Wall Street Journal*. June 29, 2023

5 For a description of the air war over the UK in World War I, including the devising of the integrated air defence system, see Fedette R. H, *The Sky on Fire, The First Battle of Britain 1917–1918,* University of Alabama Press 1991, reprinted 2007.

6 For the history of US continental air defence after World War II, see Schaffle, K., *The Emerging Shield: The Air Force and the Evolution of Continental Air Defence 1945–1960*, Office of Air Force History, 1991, at //efaidnbmnnnibpcajpcglclefindmkaj/https://media.defense.gov/2010/May/26/2001330263/-1/-1/0/emerging_shield.pdf

7 For a comprehensive history of the USSR's early efforts in ballistic missile defence, see Gruntman, M., 'Intercept 1961: The Birth of Soviet Missile Defence', The American Institute for Aeronautics and Astronautics, Reston Va., 2015.

8 See, Baucum, D. H,. *The Origins of SDI*, University of Kansas Press, 1992.

9 The term 'cruise missile' is somewhat misleading. From the technical aspect, cruise missiles are not 'missiles' but uncrewed air vehicles (UAV) that rely on an air breathing motor for propulsion, and wings for lift (contrary to the wingless, rocket powered, ballistic missile).

10 The perfection of the fuel thrifty small fan jet engine, and the precise navigation by earth contours (TERCOM)

11 Save the radio proximity fuse which enhances the score of the anti-aircraft gun.

12 Another way to overload a defensive system is by presenting it with a large number of false targets, or decoys. However, the technological aspects here are somewhat blurred since it depends on devising successful decoys that emulate the real threat, and also on the defender's capability to discriminate between true and false targets—a capability that is not static but evolves in time with the evolution of detection technologies. Hence, this essay does not expand on saturation by decoys.

13 See Karnozov V., 'Putin Unveils Kinzhal Hypersonic Missile', *AIN* March 2, 2018, at https://www.ainonline.com/aviation-news/defense/2018-03-02/putin-unveils-kinzhal-hypersonic-missile

14 See Montgomery M. H. and Nelson A. J., 'Ukraine and Kinzhale: Don't Believe the Hypersonic Hype', Brookings, May 23, 2023, at https://www.brookings.edu/articles/ukraine-and-the-kinzhal-dont-believe-the-hypersonic-hype/

15 This phenomenon was first observed during the development cycle of the first ballistic missile ever—the German V2, during its initial testing phase. To correct this fault, the structure of the fuselage had to be strengthened, which caused a one year delay in the devilment programme.

The phenomenon was observed once more during the first Gulf War (1991), when Iraq's extended range Scud missile broke up during re-entry, degrading their accuracy by about one order of magnitude.

16 The US Space Shuttle was an early example of a hypersonic glide vehicle.

17 'Ukraine Saya Russia Has Fired Five Zirkon Missiles At Kyev This Year', Reuters, April 1, 2024, at https://www.reuters.com/world/europe/ukraine-says-russia-has-fired-five-zircon-missiles-kyiv-this-year-2024-04-01/

18 For example, the Turkish Bayractar TB2 reconnaissance attack UAV, made world famous in the second Nagorno Karabagh war, has a wingspan of 12 meters, compared to the 10 meter wingspan of the F 16 combat aircraft, or the 11 meter wingspan of the Cessna 182 Skylane light aircraft.

19 Tiwary, S., 'Russia 'Shot Down' Over 100 Bayraktar TB2 Drones In The Ukraine War & Kicked Them Out Of Action – Moscow', *The EuroAsian Times*, September 4, 2024, at https://www.eurasiantimes.com/russia-shot-down-over-100-bayraktar-tb2-drones-in-the-ukraine/

20 According to the Commander in Chief of the Ukrainian Armed Forces, the Russians has launched at least 13,315 drones against Ukrainian targets since the beginning of the war. See, 'Ukraine Discloses For The First Time Real Missile Interception Rates Against Various Kinds of Russian Missiles', *BNE Intellinews*, August 24, 2024, at https://www.intellinews.com/ukraine-discloses-for-the-first-time-real-missile-interception-rates-against-the-various-kinds-of-russian-missiles-340139/

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22 The historic parallel to the German V1 campaign against Britain in 1944–45 is noteworthy. The V1, dubbed at the time as the 'Flying Bomb', was the first cruise missile ever. The British, forewarned about the coming threat, devised a multi belted defence system, alternating fighter aircraft and anti-aircraft artillery belts. At its peak, the defence array managed to destroy 90% of the incoming V1s. Yet, the 10% that leaked through caused significant damage and loss of life in London.

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PART V

Strategic Partnerships: Enhancing National Security through Collaboration

14

Collective Security in (Eur)Asia: Views from Moscow and from New Delhi

Andrey Kortunov

The idea of a collective security system in Asia has become a subject of discussion in both Russia and India. The two nations, given their size, power, history, military capabilities and political ambitions, have a lot of impact on the overall strategic situation in this part of the world. As such, both are destined to play an active role in designing and erecting a new continental security architecture. Since bilateral Russia–India relations have always been marked by mutual affection, empathy and respect, it is suggested that the leaders of the two countries work together to achieve the desirable collective security in Asia. Indeed, the overall principles of collective security, as articulated by Russian and Indian leaders, are very similar to each other. There also seems to be a lot of personal chemistry between President Vladimir Putin and Prime Minister (PM) Narendra Damodardas Modi, which should help the two statesmen to harmonise their visions of the future of Asian security. This chemistry was manifested, once again, when Modi chose to visit Moscow in July 2024, on his first foreign trip after becoming the PM of India for the third time.

Although the security concerns and challenges that Moscow and New Delhi face these days are often overlapping, they are not completely identical. On top of that, the two states have different foreign policy experiences, decision-making mechanisms and diplomatic traditions. Differences in the two political systems also play a role in how they approach security matters in Russia and in India. Therefore, a closer look at the Asian security perspectives of both the nations may

be helpful. This chapter focuses not so much on the common but rather divergent views that need be kept in mind while trying to forge new proposals on security in Asia and beyond.

Threat Perceptions

Needless to say, there is a lot of concurrence between Moscow and New Delhi on a broad range of security challenges across Asia. Both nations are concerned about potential regional crises that might break out in various places of the continent, such as, in Afghanistan or Myanmar, in Central Asia, in the Middle East or in the South Caucasus. Historically, too, the two countries have been vulnerable to international terrorism. Other issues of concern are continental food and energy security, transcontinental migrations and global climate change implications for Asia. Neither country is interested in nuclear proliferation in Asia, or in an uncontrollable conventional arms race on the continent. However, there is still a visible divergence of positions on, or approaches to, some of the main sources of security threats to Asia, as currently seen from each of the two capitals.

For foreign policy decision makers in Moscow, the core security challenge to Asian countries comes from overseas Western powers that have got involved in the continent over the past centuries, and that have always been committed to keeping Asia disunited and fragmented to the extent possible in order to exercise an external control over the continent and exploit Asia's abundant natural and human resources. The political mainstream narrative in Moscow suggests that the Great Britain was central in playing this disruptive role till the middle of the last century; and later on, Washington replaced London on the Asian stage in its efforts to keep the continent divided and vulnerable to malevolent Western influence. This vision, to a large extent, reflects the current intense geopolitical conflict between Russia and its Western opponents and is an organic part of a more general Russian leadership's view of the world.

Therefore, it is considered indispensable for Russia and its partners in Asia to contain military blocks and political alliances created under the United States (US) auspices, such as the trilateral security partnership between Australia, the United Kingdom and the US (AUKUS) and the Quadrilateral Security Dialogue (Quad). It is further believed that the US' partnerships with Japan, South Korea and the Philippines cannot be treated as contributors to ensuring continental security, but instead should be regarded as obstacles on the road to a collective security system in Asia. Another dangerous trend in Asia, as seen by the Kremlin, is the continuous process of North Atlantic Treaty Organization's (NATO)

globalisation, in particular its ongoing activities in the Pacific Ocean and the Indian Ocean that reached a new level after the 2022 summit in Madrid.[1]

Meanwhile, the continental security landscape, as seen by New Delhi, is quite different from the vision projected by Moscow. Despite understandable negative sentiments associated with the colonial period of national history, most of the Indian politicians and scholars tend to take a more benign approach to the external political and even military presence on the Asian political and security stage, assuming that given the internal dynamics within Asia, this presence can no longer be decisive. Asia is perceived to be big enough to accommodate everybody, including powerful external actors. For India, the real challenge to Asian security comes not from the remote US or the NATO, but rather from neighbouring China, which allegedly displays a clear intention to become the continental, if not the global, hegemonic power, pursuing the goal of constructing 'a uni-polar Asia in a multi-polar world'.[2]

Though the specific attempts by the US to put together various multilateral and bilateral security arrangements to contain China (the AUKUS, the trilateral Washington–Tokyo–Seoul cooperation in Northeast Asia, the US–Philippines security partnership and so on) are followed as closely by New Delhi as by Moscow, the policy conclusions made in India are very different from those made in Russia. Some Indian experts argue that if all the US multilateral and bilateral arrangements succeed in blocking Beijing's intended advances along the Pacific Ocean and Indian Ocean coastlines, China might opt to focus its activities on the disputed Himalayan border with India, where New Delhi is not in a position to reset the power equilibrium that, as of now, favours Beijing.[3] This means that in order to avoid being left out in the cold, India has no other choice but to join the US, and the West at large, in trying to deter Beijing through participating in various US-led multilateral bodies.

The attitude towards Washington and Beijing constitutes by far the most important and fundamental difference in Russia and India's takes on the Asian security agenda. The challenge for the Russian leadership is how to balance its rapidly expanding foreign policy and defence ties to China and the stated commitment to an inclusive collective security system in Asia.[4] The challenge for the Indian leadership, in turn, is how to balance its growing engagement with the US and its ambitions to play a more central role in Eurasian security matters. These challenges are likely to have a lasting impact on Russia and India's foreign policy agendas, and might also affect their bilateral relations.

Potential Participants to the System

If the main security challenge comes from overseas, it would be logical and appropriate to limit the involvement of external players in the Asian security arrangements to as little as possible. In other words, Asian problems should have Asian solutions. President Vladimir Putin has argued that the existing military presence of Western powers in Asia (including the US military bases and other Western military infrastructure) is nothing but a residual legacy of the Cold War; and it should be brought to the minimum and ultimately, completely eliminated.[5] Of course, the proposal is explicitly directed against the US and the NATO, which has stated its intention to continue increasing its political and military presence along the Indian Ocean and Pacific Ocean coastlines and deeper in the Asian mainland. The spectacular failure of the 20-year-long NATO engagement in Afghanistan is often referred to in Moscow as an example of the destructive and self-defeating role that the US, and the West at large, has historically played in Asia's security matters.[6]

This is not the view that would find many enthusiastic champions within the Indian political and defence establishment. Though the overall idea of gradually eliminating all external military presence in Asia is hard to oppose, the predominant opinion in New Delhi is that, currently, there is simply no combination of local actors that could, even in theory, reliably balance the overwhelming military might of China. The strategic position of India in Asia is further complicated by its long-term conflict with neighbouring Pakistan, which is likely to be on the side of Beijing in any potential China–India conflict. Given these realities, an engagement of overseas players is, in general, regarded by New Delhi not as a negative but rather as a positive factor, contributing to credibly containing Beijing's hegemonic ambitions.

From the Indian strategic perspective, Washington and Brussels (the latter stands for both NATO and the European Union [EU]) are not so much a part of the problem as part of the solution for Asia's security problems. Asia as an international sub-system open to external influences has clear advantages compared to Asia as a closed sub-system with potential security deficits. This situation can change only if, in some future, India, together with its Asian partners, is in a position to balance China without involving external actors, or if India and China can reach a strategic breakthrough in the overall bilateral relationship, which looks unlikely to happen anytime soon.[7]

This divergence of views explains why Russia and India have such different

attitudes towards the concept of Indo-Pacific. Moscow often looks at this concept as a US-designed strategic framework aimed at insulating China in the region and turning nations along the Indian Ocean and the Pacific Ocean into obedient vassals of Washington. Moreover, Russian decision makers often argue that one of the strategic goals of the concept is to marginalise Moscow in, or even exclude it from, this vast geopolitical space and therefore, the concept should be regarded as not only anti-Chinese but also anti-Russian.

New Delhi, on the other hand, does not miss a chance to remind Russia that the Indo-Pacific concept did not originate in the US, but rather in Japan and India. Further, it is felt that the concept is not about consolidating the US hegemony but about maintaining Association of Southeast Asian Nations' (ASEAN) centrality in this huge economic and geopolitical space.[8] The Indian perception is that the concept is not directed against Russia and therefore, Moscow has no reason to worry about it. Furthermore, India could even assist Russia in getting its entrance ticket to the club of Indo-Pacific nations, if Moscow decides to pursue this goal.

Prior to the launch of the special military operation in February 2022, there were active discussions within the Russian expert community if Moscow should indeed change, or at least modify, its explicitly negative approach to the Indo-Pacific concept, with some analysts arguing that this concept should be regraded not as only a challenge but also as a historic opportunity for Russia.[9] However, it seems that the evolving geopolitical context has marginalised such contrarian views within the Russian expert community.

Geographical Scope of the System

With regard to the geographical scope of a collective security system, Russia seems to take a more inclusive approach compared to India. In Putin's view, the new Eurasian (not even Asian) system should start with a dialogue between already existing organisations, such as the Russia–Belarus Union State, the Collective Security Treaty Organization (CSTO), the Eurasian Economic Union (EAEU), the Commonwealth of Independent States (CIS) and the Shanghai Cooperation Organisation (SCO). Furthermore, other influential Eurasian associations from Southeast Asia to the Middle East should join this multilateral arrangement. Both regional platforms—that is, the ASEAN, the South Asian Association for Regional Cooperation (SAARC), the Bay of Bengal Initiative for Multi-Sector Technical and Economic Cooperation (BIMSTEC) and the Gulf Cooperation Council

(GCC)—and inter-regional ones—ASEAN+ and Conference on Interaction and Confidence-Building Measures in Asia (CICA)—can be potential participants in the initiative. It goes without saying that any meaningful multilateral interaction within such a diverse group of institutions would be extremely complicated and, at least at the initial stages of the dialogue, not very productive, but it is still worth trying.

As viewed by Moscow, the system should ultimately embrace all nations of Asia and Europe, including members of the NATO (with the notable exception of the US) and members of the EU.[10] The underlying assumption is that at some point, the European partners of the US, along with Washington's East Asia allies, should demonstrate a new level of 'strategic autonomy' from the US, with their newly acquired Eurasian ties gradually overshadowing their old transatlantic bonds, which no longer serve fundamental Europe's interests; in other words, the US has no right to dominate Europe forever, like it has no right to dominate Asia. In a way, this concept of 'Greater Eurasia' can be tracked back to the idea of 'Greater Europe', stretching from Lisbon to Vladivostok, that was popular in Moscow some 20–25 ago. The difference, however, is that in the past, 'Greater Europe' implied that pan-European institutions would gradually expand to Asia through Russia, Central Asia and the South Caucasus, while the 'Greater Eurasia' concept assumes that the European peninsula will be gradually absorbed by a much larger and more dynamic Asian continent.

The Indian approach to future collective security in Asia appears somewhat less ambitious, but arguably more practical. The position articulated by PM Modi during his brief trip to Ukraine on 23 August 2024 suggests that the Indian leadership does not consider Russia–Ukraine conflict, as important as it is, to have an immediate formative impact on security in Asia and it should, therefore, be considered in the European rather than the Eurasian context. However, as a leading power in the Global South, India is ready to do its best in trying to put the fratricidal conflict to an end.[11] The sheer notion of 'Eurasia' in New Delhi often stands primarily for Central Asia and Afghanistan; indeed, it seems that the Indian leadership considers the Asian—let alone the Eurasian—continent simply too big and too diverse to be covered by a single comprehensive security arrangement.

It may thus be more appropriate, from the Indian viewpoint, to take a piecemeal approach to try to identify specific 'region-tailored' security arrangements for Northeast Asia, Southeast Asia, South Asia, Central Asia, the

South Caucasus, the Middle East and so on. Maybe, in some cases, the approach should be even more incremental: in the Middle East, for example, one should single out the Gulf area as a separate sub-region with its own security dynamics. Each case should have its own list of participants, rules of engagement, security priorities and expected institutional arrangements. For instance, continuous Indian interest in the SCO largely depends on the ability or inability of this organisation to make a viable contribution to political stability and economic progress in Afghanistan, which was reflected in the India's 2023 SCO chairmanship agenda.[12] Maybe, at some point in time, all of these smaller security arrangements will merge into a more universal Asian or even Eurasian collective (or more limited cooperative) security system, but one cannot possibly hope that this will happen in the foreseeable future.

In many ways, India's security strategy is still focused on its immediate neighbourhood and the Indian Ocean Region. New Delhi emphasises the need for 'zone balancing', which would allow to deter coercion from external powers (mostly China) while fostering security cooperation with littoral states. Certain initiatives, like the Indian Ocean Rim Association and the Indian Ocean Naval Symposium, showcase India's intent to establish itself as a responsible regional leader and a key security provider in South Asia.[13] It would be fair to conclude that the remaining focus on the immediate South Asia neighbourhood allows New Delhi to test specific procedures, mechanisms and security regimes that could be later applied at a higher than sub-regional level.[14]

In a way, this distinction between the two visions—one more universal and other more incremental—of Asian security reflects different schools of foreign policy thinking that dominate the expert and political discussions in Moscow and New Delhi, respectively. In Russia, the tilt is towards a deductive paradigm in international relations, assuming that one should start with addressing bigger strategic problems and then go down to smaller tactical ones. The Russian, formerly Soviet, tradition has always put special emphasis on general frameworks and fundamental principles (like the Helsinki Decalogue—the 10 provisions of the Final Act of the Conference on Security and Cooperation in Europe, signed on 1 August 1975 by the leaders of 33 European countries, the US and Canada). Some foreign experts conclude that the recent Russian proposals on Eurasia security system are aimed at gradually building something like a Eurasian model of Organization for Security and Co-operation in Europe (OSCE).[15]

However, even Russians themselves are doubtful that anything like a new

Helsinki Final Act will find a lot of support in South Asia,[16] especially in view of the ongoing complete desegregation of European security institutions. In fact, the ongoing West–Russia crisis has been a heavy blow to the top-down approach to international security arrangements not only in Europe but everywhere. In India, the inductive paradigm seems to be more popular, that is, one should start dealing with smaller incremental matters first, and then, when the participating sides accumulate enough mutual trust and experience in working together, they can try climbing up to more sensitive, controversial or more strategic matters. Only future can tell us whether this bottom-up approach can lead to a multi-dimensional and sustainable security system in Asia.

The Legal Arrangements

Historically, Russia has always taken a more legalistic attitude to international relations than India; the former inherited mostly continental European international public law culture and constitutional traditions, while the latter emerged under a strong influence of Anglo-Saxon precedent law tradition. The importance of strict adherence to formal norms of international public law is emphasised in the new version of the Foreign Policy Concept of the Russian Federation, adopted in March 2023. In the document, there is also a clear distinction between 'international law' and 'rules-based order'. It is articulated that any 'further promotion of the concept of a rules-based world order is fraught with the destruction of the international legal system and other dangerous consequences for humanity.'[17]

The legal purity of potential international arrangements has always been a matter of concern to Russian diplomats involved in drafting bilateral and multilateral treaties, agreements, etc. The Russian leaders are apparently convinced that informal commitments, which are not legally binding and not accompanied by proper verification mechanisms, are not likely to work out or be sustainable over time. The predominant perception in the Kremlin is that the Western partners let Russia down many times after the end of the Cold War by making various informal commitments (like the alleged commitment, in 1990, not to advance NATO in the eastern direction) that did not last for too long.

India, in comparison, appears to be much more relaxed about the legal dimension of future collective security arrangements in Asia. The Indian leadership may, in fact, be purposely unwilling to enter into various legally binding agreements because these agreements could limit the country's foreign policy freedom of action that is highly valued by New Delhi. Even the term 'alliance' is viewed with suspicion

by many in the Indian strategic community.[18] After all, a nation can always find a way to walk out of any legally binding international treaty if it comes to the conclusion that this treaty no longer serves its interests. A continuous commitment to an international agreement should be based not so much on any specific legal formulas and intrusive verification procedures, but rather on the understanding that the agreement serves specific national interests.

It is important to note that over the last decade, since PM Narendra Modi took office for the first time in 2014, India's approach to collective security has evolved significantly due to the changing geopolitical environment. In spite of the traditional emphasis on maintaining strategic autonomy and principles of non-alignment, India has started building bilateral relations with major powers, gradually developing an appetite for more than purely sub-regional collective action and multilateralism.[19] However, this transition is not yet complete and might not result in India's acceptance of the Russian legalistic position on international security in Asia. It would be fair to say that New Delhi has accumulated more experience in development-focused rather than security-focused multilateralism.[20] Moreover, the ongoing shifts in India's approach to multilateralism might signal a gradual transition in the direction of multilateral containment and deterrence, rather than collective security as understood by Moscow.

This difference in approaches partially explains why Russia has always insisted on legally binding commitments from its arms control negotiation partners; and India, meanwhile, has often been reluctant to advance a fast institutionalization track for important entities, such as the SCO, the BRICS (Brazil, Russia, India, China and South Africa) or even the Quad.[21] In all these settings, New Delhi would prefer to have commitments *à la carte*, that is, to give participating sides the right to decide on the preferred levels of their specific involvement in particular projects or formats of cooperation. The legalistic approach, though undoubtedly ambitious, is more rigid, while the situational approach, which might be ambiguous, is more flexible, which is very important under the current challenging political circumstances.[22]

Security and Development

The Russian approach to Asian collective security system implies close links between security and development as the two most important dimensions of a desirable future Asian order. Future security mechanisms should be complimented by trade facilitation, financial integration, continental transportation corridors,

multilateral development projects, human contacts and so on. In Russia, like in India, there are some who remain concerned about the economic might of a rapidly growing China (and this might be one of the reasons why Russia, like India, never directly joined the Chinese Belt and Road Initiative). Nevertheless, Moscow tends to believe that there can be no sustainable development without security and no stable security without development.[23] This is why Moscow has always tried to get a balanced mix of security and development cooperation components with both China and India—being more successful with Beijing than with New Delhi. The inseparable connection between security and development is particularly explicit is certain areas, such as terrorism, environmental threats, climate change, the spread of organised crime and human trafficking. For Russia, however, security has always played the leading role and immediate economic interests have always been subordinated to more important security priorities.

In principle, such an approach should not meet any resistance in India. The national leadership under PM Narendra Modi also puts an emphasis on common development as a top priority,[24] which definitely has a profound impact on the nation's foreign policy and security priorities. Still, it looks as if New Delhi tends to take a more compartmentalised approach to security and development than Moscow. For instance, for a long time, India had great political relations with Russia, while the economic dimension of this relationship was clearly underdeveloped. This very evident gap between the political and economic dimensions of the bilateral relationship was a matter of concern for both the counties, but did not seem to negatively affect the ability of the two sides to work together on important security-related matters.

On the other hand, it is clear that New Delhi considers Beijing to be not only a formidable geopolitical adversary but also a powerful economic adversary. This is one of the reasons why India, for instance, decided to stayed out of the Regional Comprehensive Economic Partnership, but joined the US-initiated Indo-Pacific Economic Framework. At the same time, despite all the political disagreements and even direct military clashes between the two nations, in the fiscal year 2023–24, China emerged as India's top trading partner, with the two-way trade amounting to approximately $118.4 billion, slightly surpassing the US, whose trade with India amounted to $118.3 billion during the same period.[25] It would be impossible to imagine Russia–US trade booming in a similar way, parallel to growing political tensions between the Kremlin and the White House. This difference between Moscow and New Delhi is not accidental and is rooted in

deep distinctions between the Russian and Indian economic and political systems: in Russia, even the most important economic interest groups have always been less powerful than similar groups in India.

Both approaches have their respective advantages and disadvantages. On the one hand, in the twenty-first century, it is becoming increasingly hard to separate security and development. On the other hand, overloading the security agenda with development items might make an agreement too complicated and almost impossible to achieve. Besides, if long-term development prospects are completely subordinated to immediate national security interests, serious distortions of the foreign policy agenda become very likely, if not unavoidable.

Moving Forward

The brief outline of Russia and India's approaches to the idea of collective security in (Eur)Asia reveals a certain paradox and even a challenge to contemporary international relations theory. As a rising great power, India is supposed to demonstrate a more revisionist foreign policy pattern, insisting on fundamental changes of the international system which was, to a large extent, shaped before India even got its independence. On the other hand, Russia, as a mature great power, should stick to the existing status quo, since this status quo guarantees Moscow a very special status within the system. However, in reality, we observe a completely opposite picture: India tends to take a rather cautious approach to international system transformation, while Russia calls for a comprehensive revolution that would change the system once and forever.

Still, none of the above-mentioned differences in Russia and India's approaches to continental security should prevent the two nations from working hand in hand with each other on many practical security matters. One can even argue that the Russian and the Indian approaches to security matters complement each other and should generate the synergy needed to address the very complicated Asia security agenda. In many ways, the two nations can learn a lot from each other. Russia can share with India its diverse experience in global politics, including in critical areas, such as strategic stability, arms control and international crisis management in remote parts of the world, while India can offer Russia its experience in building a friendly neighbourhood, in well-calibrated 'zone balancing' and, above all, in exercising appropriate 'strategic patience' in dealing with critical security challenges.

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15

Enhancing National Security through Collaboration: The EU–India Strategic Partnership

Frédéric Grare

On 17 January 2024, the European Parliament addressed its recommendations 'to the Council, Commission and the Vice-President of the Commission/High Representative of the Union for Foreign Affairs and Security Policy concerning EU–India relations'. The document acknowledged 'the increasing importance of security cooperation in the partnership' and formulated recommendations to improve cooperation in various fields, such as police cooperation, maritime security, disarmament and non-proliferation, space, humanitarian aid, infrastructure development and connectivity. More importantly perhaps, it recommended enhancing cooperation on hybrid threats, with particular emphasis on the fight against disinformation campaigns. Dialogues about relations with China and Russia were also part of the European Union (EU) Parliament prescriptions.[2]

The EU Parliament recommendations were only the last in a series of documents which, since 2004, have constantly reiterated the need for and potential of cooperation between the two entities. The strategic partnership between the EU and India dates back to the 2004 Hague Summit, some 40 years after India and the then European Economic Community established diplomatic relations. From the beginning, the partnership generated great hopes on both sides that cooperation would rapidly develop in the fields of trade, connectivity, development

and defence or regional security. The potential was obvious to all and both sides were confident that there was space for mutual actions and projects. However, despite the best of intentions, reiterated in every joint document since 2004, the security dimension of the strategic partnership never really took off and very little real cooperation in key areas occurred.

It took indeed a long time for the partnership to include a significant security dimension. Individual EU member states did cooperate with India in defence production, and exercised with its armed forces. Even when involved in the same theatres, like in Afghanistan, the EU member states and India hardly consulted each other, let alone coordinated their activities. The EU was—and to some extent still is—seen in India as a supranational organisation that was struggling to form a common front on military and defence activities. The Indian policymakers, thus, did not consider the EU as a full-fledged security actor.

Today, the situation is rapidly evolving due to many reasons: a better understanding of the importance of the Indian Ocean, which is described in the EU Strategy for Cooperation in the Indo-Pacific as the gateway to the Indo-Pacific; a better understanding of the nature of the threat posed by China, in particular the weaponisation of all activities by China, blurring the lines between traditional and non-traditional threats, as well as the consequent emergence of grey zones; questions regarding the commitment of the United States (US) to the security of the area and therefore, to the security of the European sea lines of communication (SLOCs); and a better understanding of Europe's actual capabilities.

In this context, the EU Strategy for Cooperation in the Indo-Pacific is the start of a new phase in the security relationship between the two entities. It is still prospective though—more a potential on which the security cooperation could and should be built, than a reality. The strategy is deeply reflective of the EU's understanding of the nature of the threat as well as of the capacities it can dedicate to the Indian Ocean Region (IOR). The EU's willingness to address these issues and the elaboration of an EU Indo-Pacific strategy, with an intent to focus on non-traditional and hybrid threats, opens potentially a vast field of cooperation in a space where none of the two entities has the capacity to act alone. Moreover, the very nature of the activities at stake makes the process inherently cooperative, a characteristic that only adds an element of complexity. The security cooperation between India and the EU is likely to be an incremental process at best.

Determinants of the EU–India Security Partnership

Although India and Europe have entertained diplomatic relations since 1962, both have evolved in relatively alien strategic spheres for a long time. Some scholars have attributed this to differing worldviews and perhaps a quasi-civilisational competition.[3] These factors cannot be dismissed as historical determinants, but have been less determined by strategic reasons than fundamentally different threat perceptions in India and Europe. India, for instance, was both distant and proximate to the Union of Soviet Socialist Republics (USSR) until the end of the Cold War. So, though India was never part of the Soviet bloc, it entertained a friendly relationship with Moscow. This was in sharp contrast with the EU which saw the USSR as an existential threat. Reminiscences of that period came back to haunt India–EU relationship after Russia's aggression of Ukraine, generating, again, misunderstanding between Brussels and New Delhi.

The post-Cold War reorientation of India's foreign policy changed the trajectory of the relationship. India's rapprochement with the US led to the first, even if largely inconsequential, rapprochement with the EU. The asymmetry of power between the two entities persisted and their respective security agendas did not overlap. Russian revanchism, Islamist terrorism, as well as the fear of instability on its periphery, dominated the EU's threat perception, whereas cross-border terrorism from Pakistan-based terrorist groups and a growing Chinese economic and military presence both on land and at sea obsessed India. With the exception of Russia's role, the threat perception of the two entities did not fundamentally differ in nature, but it did not overlap and could lead to no more than general convergence of interest.

More importantly, the EU did not have any strategic ambition of its own and was not even willing to consider the strategic consequences of its own commercial success, nor to assume the financial cost of the protection of its own interests, which it perceived as limited. The Indian Ocean, by which most of Europe's outside trade transits, was merely seen as 'a body of water surrounded by land, and not a strategic nexus',[4] with most of the EU member states ready to leave the protection of the SLOCs to the US. Further, major differences related to nuclear proliferation persisted between India and many member states, even though India had violated no international commitment.

Terrorism, nevertheless, soon led to a greater alignment of India and the EU perspectives on security matters. The 9/11 attacks in the US and the subsequent experience of terrorism on its own soil led to a better European understanding of

India's predicament. The war in Afghanistan also changed Europe's perception of and attitude vis-à-vis Pakistan, reducing—if not eliminating—a source of irritant with India. Counterterrorism found its way in the joint action plan of the 2005 'India–EU Strategic Partnership',[5] the 2010 'India–EU Joint Declaration on International Terrorism'[6] and the various agendas for action between the two entities, including the 'Roadmap to 2025'.[7]

Changing International Circumstances and the Cautious Evolution of the EU

A series of factors contributed to the change in the EU's posture and, consequently, in assuaging India's reservations. The 2016–20 Trump presidency challenged the EU's confidence that the US would inevitably come to its rescue should the need occur. As early as 2017, German Chancellor Angela Merkel declared that the 'EU [could not] completely rely on US and Britain anymore'.[8] Then followed a series of steps to build up the EU's autonomy, even if many member states were still reluctant.

Russia's invasion of Ukraine, despite the EU and India's differences over the issue, strengthened the conviction of both the EU and its member states that the time of free-riding was over and that rearmament was necessary. Moreover, though it distracted the EU member states from the Indo-Pacific theatre, the invasion paradoxically contributed to reinforce the conviction in Europe that Beijing was as much, if not more, of a problem as Moscow. Indeed, the EU started believing that China had the intent and capacity to challenge the rules-based international order that Europe, among others, had been striving for since the end of World War II, de facto reinforcing India's importance for Europe.

In parallel to these changing circumstances, the adoption of the EU Global Strategy and the Strategic Compass, respectively in 2016 and 2022—promoting a prospective international security role and expressing the goal of an EU strategic autonomy—did not per se enhance the cooperation but created a more favourable environment, as India was fundamentally attached to its own strategic autonomy.

China's Role in the Rapprochement between India and the EU: The Evolving Nature of the Threat

China, directly and indirectly, was the major vector of rapprochement between India and the EU. Ever since the 1962 war, China was perceived as the main security concern for India—a trend reinforced in the 1990s when New Delhi

started realising that Beijing's 12 years heads-up in economic reforms had led to a growing power asymmetry between the two countries.

In contrast, for a long time in the EU, China was seen primarily as a phenomenal economic opportunity; and it emerged, only recently, as a security problem. The different perception of China by India and the EU prevented the development of stronger security cooperation between the two entities. For instance, India opposed the Chinese Belt and Road Initiative (BRI) early on, but the EU member states were much more cautious.

In recent years, the evolution of the nature of the threat, as much as its origin, has changed the perceptions on the European side, opening a new venue for interventions more in line with European capacities. The entire IOR has experienced growing militarisation, complemented by a shift of threat from traditional to hybrid, as well as the emergence of grey zones.

The current militarisation of the region is the outcome of China's growing presence, both direct and indirect, in the Indian Ocean. The deployment of Chinese nuclear-powered submarines, the sale of 10 submarines to India's closest neighbours (two to Bangladesh and eight to Pakistan)[9] and the building of a base in Djibouti are well known. They are all contributing to the militarisation of the IOR, acting as a catalyst, prompting a regional arms race and facilitating indirectly the emergence of new, if lesser, actors in the process,[10] even if the region still relies mostly on external actors for the protection of the SLOCs. The spill over of regional conflicts (Yemen, Mozambique in the maritime domain), combined with the import of geopolitical tensions, has the potential to undermine the already fragile stability of the entire region.[11]

Furthermore, China's emergence as a global power and its capacity to weaponize all activities, from trade to climate change, to serve its geopolitical objectives changes the nature of the threat. At stake are the integrity and security of supply and value chains. The COVID-19 crisis did act as a trigger for a series of policies aimed at better controlling China's economic relations with Europe and led to greater realisation that excessive dependencies on China are likely to affect not only the sovereignty of the EU and India but also of their respective neighbourhoods.

Despite a common diagnostic regarding the risk China poses for Europe, it has taken a long time for the EU to harmonise, even if incompletely, the positions of its member states. 'Individual vulnerabilities and the degree of political risk each country was willing to take in its relation with Beijing inhibit the definition

of a common position.'[12] Even the qualification of China as a 'partner, competitor and systemic rival'[13] as early as in 2019, a perspective which was not dissimilar to India at the time, has not eliminated all differences among the Europeans.

India and the EU Responses

In spite of the geopolitical developments, security cooperation between the EU and India has remained largely aspirational and devoid of any significant ambitions. For instance, though the 'Roadmap to 2025', signed in 2020, has placed security cooperation at the forefront, it speaks only in general terms of the need to: 'work towards tangible outcomes, on shared objectives of non-proliferation…establish regular security consultation between the EU and India...strengthen military to military relations and exchanges, establish a maritime security dialogue', as well as 'deepen the cooperation between the European Union Naval Force (EUNAVFOR) ATALANTA and the Indian Navy'.[14]

It is true that this represents a significant improvement compared to the previous period, but no specific objectives have been set and the outcome looks more symbolic than substantial. To quote US-based French analyst Olivier Blarel: 'the EU had neither the institutional tools nor the strategic interest necessary to foster a substantial security partnership with India. For its part New Delhi had reservations about cooperating with a distant political actor that it failed to fully comprehend.'[15] Limited military capacities of both India and the EU (despite France's persistent argument in favour of a military force)[16] to help one another on security matters further exacerbate the problem.

Yet, this assertion needs to be nuanced. The EU, which had launched its own programmes in specific fields, such as maritime domain awareness, through its Critical Maritime Routes in the Indian Ocean (CRIMARIO I and II), or anti-piracy (EUNAVFOR/ATALANTA), has contributed to the military response too, even if modestly. In 2021, India and the EU conducted their first joint naval exercise in the Gulf of Aden. In October 2023, the EU and India conducted joint naval exercises in the Gulf of Guinea.[17] Recently, during the 2024 Paris Indo-Pacific Ministerial Meeting, India accepted the invitation to participate in the Coordinated Maritime Presence launched by the EU in the Indian Ocean.

The institutional security cooperation between Brussels and New Delhi does not adequately represent the reality of defence cooperation between India and Europe. For instance, India has responded to China's militarisation of the Indian Ocean by launching a vast programme of military procurement, for which

European member states and their private or semi-private sectors are competing, thereby contributing to India's defence effort.[18]

However, New Delhi's aim to become not only self-sufficient but also a net defence exporter will have a significant impact on the future of India–EU cooperation. In defence, like in other matters, India intends to become a manufacturing hub for European defence industries, helping the country on its way towards self-sufficiency. Currently, industrial defence cooperation with India is still limited and though European defence industries are eager to enter the Indian market, they are much less willing to transfer technologies as requested by the Indian side.

Prospects for the EU–India Security and Defence Cooperation

The EU's adoption of an Indo-Pacific strategy in September 2021, followed by the announcement of the Global Gateway three months later, has opened up the possibility of a different and new set of security cooperation between India and the EU.

This strategy signals the official recognition by the EU of the importance of a concept fundamental for India, the Indo-Pacific, further indicating the willingness to exercise its security responsibilities in this context. It prioritises the Indian Ocean, 'a gateway for Europe into the Indo-Pacific', indeed 'the principal passage for Europe to and from Indo-Pacific markets' and an area, therefore, where 'freedom of navigation is...vital'.[19]

The EU Indo-Pacific strategy addresses all of the issues that put China at odds with a substantial part of the international community, from democracy and the rule of law to security and prosperity. The strategy is a response to the hybrid character of the Chinese offensive. Espousing a comprehensive approach towards security, the EU strategy defines seven priority areas (namely, sustainable and inclusive prosperity; green transition; ocean governance; digital governance and partnerships; connectivity; security and defence; and human security), all of which are part of the Indo-Pacific agenda defined in various documents which structure India's own vision of the Indo-Pacific. Each issue is considered for itself but also for the consequences it does entail for each of the concerned country or entity. Nearly all investments required to address these issues have a potentially strategic impact through the debt problem and the dependency it creates.

From this perspective, it is significant that the Global Gateway has been launched, which is a European strategy to boost connectivity through smart,

clean and secure links in digital, energy and transport sectors, as well as strengthen health, education and research systems across the world. With the aim to invest up to 300 billion euros from 2021 to 2027, the Global Gateway is the financial arm of the EU Indo-Pacific strategy (even if its scope is much larger, encompassing Africa, Asia and the Pacific, Latin America and the Caribbean).

The European and Indian concepts of the Indo-Pacific are indeed quite similar. Geographically, they both cover the entire Indian Ocean and extend to the South Pacific, even if the latter is more peripheral for India. As it is inherently cooperative and flexible in nature, the EU strategy does open up the possibility of thematic coalitions addressing each of the issues in an inclusive and non-overtly hostile manner.

Conclusion

Strategic synergies between India and the EU are real, but they are still to be built. The partnership is unlikely to be primarily a military partnership even if individual member states already have, and/or will establish and develop, such partnerships. Currently, India–EU industrial defence cooperation is at the nascent stage.

The EU Strategy for Cooperation in the Indo-Pacific opens a complementary route, consistent with the nature of the threat as it emerged in the first quarter of the twenty-first century. The strategy is in itself a cooperative endeavour. It has the potential to open many different paths of cooperation, not all of which will necessarily develop simultaneously, nor at the same pace. Its success will, however, depend on the speed and degree of implementation.

Both Europe and India are often slow in moving forward and questions can be asked regarding the pace at which the cooperation will be developed. Today, the war in Ukraine is distracting Europe from the Indo-Pacific and mobilising its resources. However, China's support to Russia has considerably helped to consolidate the idea of a continuity between the European and Indo-Pacific theatres and therefore, there is a need to act on both the fronts.

It is also more important than ever for both the EU and India to manage expectations and to remain alert regarding the evolution of the threat. If implemented comprehensively, the EU strategy as well as the Global Gateway have the potential to not only stop China's rise but also help manage it to conform with internationally accepted norms. This will enable the EU to work with partners, such as India, in the Indo-Pacific to uphold the multilateral rules-based order and expand the strategic space of the EU, India and their partners.

Indeed, humility and realism are the need of the hour. The EU–India security and defence cooperation is likely to be multi-layered and multidimensional, and one in which none of the actors is likely to satisfy all the requirements of the other. India, the EU member states and the Commission will have to demonstrate strong political will, both individually and collectively, in all aspects of the development of this framework for comprehensive security.

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16

Changing Trends in India–Israel Defence Equation: The Iron Swords War

Oshrit Birvadker

War can catalyse shifts in global power dynamics, prompting nations to re-evaluate their alliances based on emerging geopolitical realities. This realignment may expose latent tensions or historical grievances, leading to either strengthened cooperation among some states or the unravelling of previously stable partnerships. Since 7 October 2023, Israel has faced considerable delays in arms shipments and significant threats of an arms embargo from Western countries, a development that underscores the shifting dynamics of international support. This situation has become particularly pronounced as these threats have also emerged from Washington, Israel's most critical ally, which has employed military aid as a tool of policy leverage.[2] Such developments reinvigorate the long-standing debate among Israeli decision makers and the public regarding the consequences of Israel's reliance on American military assistance, particularly concerning its national interests and autonomy.[3]

The potential conditionality of this aid raises critical questions about Israel's ability to maintain an independent foreign policy and respond effectively to emerging security challenges, thereby highlighting the complex interplay between military dependence and sovereign decision making in a rapidly evolving geopolitical landscape.[4] India's expanding role in the international arms market, coupled with its strong defence industrial base, aligns with Israel's interest in strengthening relationships that enhance national security while preserving strategic autonomy. The deepening defence ties between Jerusalem and New Delhi reflect

not only an economic and military partnership but also a geopolitical strategy, offering Israel a crucial means to reduce its traditional reliance on Western arms and navigate the increasingly complex and multipolar global order, particularly in a time of heightened political and security uncertainty.

Arms Embargo and Limitations of Dependence on the United States

Initially, following the attack on 7 October, Israel garnered widespread support from countries across the globe. However, this initial backing swiftly transformed into vehement criticism. Subsequently, several nations decided to sever diplomatic ties with Israel, recalling their ambassadors and issuing hostile statements. Furthermore, these countries voted in favour of resolutions that were explicitly against Israel.[5] Starting in February 2024, there was a noticeable shift in international opinion regarding the implementation of an arms embargo against Israel. In France, Members of Parliament demanded detailed information from the defence minister regarding items sent to Israel. Israeli companies were also barred from participating in the annual Eurosatory arms and defence industry exhibition in May in Paris. In Ireland, a statement was approved to prohibit American planes carrying ammunition to Israel to fly through the country's airspace. Italy began covert boycotting, while England started both delaying arms shipments and participating in 'quiet boycotts'. Lately, this stance has gained support from other countries, including Canada, Belgium and Spain.[6] Additionally, major manufacturers are involved in a 'quiet boycott', which delays the delivery of raw materials for a significant Israel Defense Forces (IDF) defence project. These disruptions also extend to other critical IDF combat systems, such as the Merkava tank and Namer armoured personal carriers, which rely on hundreds of foreign suppliers.[7]

Twelve months into the war, there have been increasing international calls for an arms embargo on Israel. This is due to the nation's expansion of military operations against Iran-backed militant groups in the region. In September 2024, under Prime Minister Keir Starmer, the recently elected Labour-led government in the United Kingdom (UK) revoked 30 export licences and implemented changes that will complicate future defence exports to Israel.[8] Berlin, the prominent European supplier of arms to the Jewish state, halted arms sales to Israel since the beginning of 2024. French President Emmanuel Macron too called for an arms embargo on Israel, stating that it was the only way to end the fighting in Gaza and Lebanon.[9]

However, the most alarming acts came from Washington—responsible for over two-thirds (69 per cent) of Israel's foreign arms purchases—particularly in the context of the Rafah operation.[10] In May 2024, the embargo, which the administration preferred to call 'pause' or 'review', included 2,000 pound bombs, 500 pound bombs and holding up Joint Direct Attack Munitions, which convert unguided bombs into precision 'smart' bombs. Meanwhile, *Politico* reported that small diameter bombs were being withheld. Further, the Biden administration was said to be sitting on a deal that included tank shells and mortar rounds. All this was in contrast to the tremendous support the US showed in the first months of the war. With the outbreak of the Iron Swords war, an American air train began arriving in Israel. According to reports, 100 transport planes landed in Israel in the first three weeks of the fighting and five cargo ships docked in the ports. Along with medical equipment, vehicles and combat equipment, the supply included about 3,000 tonnes of weapons and armaments for the air force and the army. This was essential supply, without which the war effort could not have been sustained. In April 2024, by 79–18 in the Senate and 366–58 in the House, the US Congress had approved military aid to Israel. The overwhelming votes, including a majority of both parties, marked a significant defeat for the anti-Israel left.[11]

However, alongside an impressive show of support, the air train brought with it something else: it revealed the complete dependence of IDF operations on American interests.[12] Since the Six-Day War, Israel has relied on the US to shield it from international pressures, allowing it room to manoeuvre and defend itself, particularly in forums like the United Nations Security Council. This reliance is typical in the relationship between a small nation and a superpower. However, a more concerning trend has emerged in recent years, that is, a dependence on the continuous supply of ammunition and weapons. This situation undermines Israel's independence, a fundamental aspect of its sovereignty. Any military action beyond a brief operation now necessitates American support for replenishing armaments and sustaining assistance. Although this dependence is not new, the unique nature of the current conflict suggests its consequences could be more severe than ever before.[13]

American military assistance to Israel has been a cornerstone of the US–Israel relationship since the 1970s, emerging as a response to the geopolitical realities of the Cold War. This assistance, initially provided to secure Israel's survival amid hostile regional neighbours, has evolved into a comprehensive aid package that includes not only financial support but also advanced military technologies and

intelligence sharing. The Foreign Military Financing programme has been a critical mechanism through which the US provides billions of dollars annually to Israel to procure American-made defence equipment. This aid has been crucial in bolstering Israel's military capabilities, allowing it to maintain a qualitative military edge over its adversaries in the region. The support also reflects broader US strategic interests in maintaining stability in the Middle East, safeguarding its ally's security and curbing the influence of rival powers, such as Iran.[14]

The US military assistance remains vital to Israel's defence apparatus, but comes with challenges and conditions. The US has increasingly used military aid as a tool of diplomatic leverage, pressing Israel to align its policies with American interests, particularly regarding the Israeli–Palestinian conflict. For instance, the 2016 memorandum of understanding between the two countries, which commits the US to providing $38 billion in military aid over 10 years, also includes stipulations that limit how much of the aid Israel can spend domestically.[15] This has sparked debates in Israel about the nation's over-reliance on American military assistance and its potential impact on Israeli sovereignty. With shifting geopolitical dynamics and concerns over conditionality, Israeli leaders are exploring ways to diversify military partnerships. Nonetheless, US military assistance remains pivotal in Israel's defence strategy and broader foreign policy. In April 2024, the US approved $26.4 billion in emergency security assistance for Israel, including $14 billion for military aid.[16]

Despite the considerable support provided by the US military aid, there has been a growing chorus within Israel's defence circles advocating for a reduction in dependency. Their main concerns revolve around the potential loss of independence in the production of arms and the diminishing investment in Israel's own defence industry. Furthermore, critics argue that the current defensive strategy, which heavily relies on costly technological solutions and concessions of territory, should be replaced with an offensive doctrine that prioritises initiative, decisive victories and territorial control. They also contend that the reliance on military aid undermines Israel's long-term strategic goals and presents the country as overly dependent on the US, potentially weakening its position in the face of adversaries. Additionally, the increasing opposition to military aid within both American political parties, combined with growing divisions in Congress, has turned the issue of aid to Israel into a contentious political matter.[17]

The historical relationship between Israel and the US has been characterised by fluctuations, particularly in the context of military and economic support. During the 1950s, the US aid to Israel was predominantly civilian in nature,

aimed at assisting the nascent Israeli state to overcome financial adversities, often in the form of modest grants and loans. However, a significant shift occurred following the Six-Day War in June 1967, when the US acknowledged Israel's strategic significance within the broader Middle Eastern landscape. Subsequently, the US emerged as the primary source of arms for Israel, intertwining economic and security assistance. Post the 1973 Yom Kippur War, the US military aid to Israel underwent substantial escalation, with security assistance assuming a pivotal role in the bilateral relationship. Thus, despite the crucial role of military assistance, it has never been solely charitable; instead, it is deeply entrenched in a shared, enduring strategic vision between the two nations. Over time, the relationship has witnessed both peaks and troughs, including instances where the US imposed arms embargoes on Israel during its conflicts. This historical trajectory underscores their partnership's intricate and strategic nature, wherein military aid plays a critical yet contested role.[18]

Amid the escalating conflict in the Middle East, particularly with Israel's military actions in Lebanon and the worsening humanitarian crisis in Gaza, the trust between the two nations has significantly eroded. In an unprecedented move since the start of the war, in October 2024, the US explicitly threatened Israel with an arms embargo. In a formal communication to Israeli Defense Minister Yoav Galant and Strategic Affairs Minister Ron Dermer, the then US Secretary of State Antony Blinken and the then Defense Secretary Lloyd Austin called for immediate steps to improve humanitarian conditions in Gaza, setting a 30 day deadline. Indeed, if Israel does not change its military strategies and policies, it could face a critical shortage of arms, worsened by the US's ongoing delays in delivering crucial munitions, including 900 kilogram bombs.[19]

The economics of armaments has become one of the most significant issues in the context of the Iron Swords war. This war is considered as one of Israel's most notable conflicts due to several reasons, including the duration of the fighting, the extent of damage to the home front and the number of combat fronts involved—the highest since the its War of Independence. As the conflict in Lebanon escalates, marked by an increasing volume of rocket and missile attacks on Israel, there is significant pressure on Israel's defence industries to increase the production of interceptor missiles. By mid-October 2024, Hezbollah appeared to have recovered from the blows delivered by Israel throughout the previous month, as evidenced by the growing intensity and frequency of its rocket fire towards numerous locations in northern Israel, including Haifa and the surrounding areas. Despite the Israeli Air Force targeting parts of Hezbollah's

arsenal, the militant group still possesses a considerable stockpile of rockets and missiles with varying ranges, intensifying the demand for interceptors.[20]

Israel's defence industries, notably the Israel Aerospace Industries (IAI), have been operating in emergency mode since the commencement of the war. These industries have been running specific production lines round the clock to ensure a continuous supply of military equipment, including interceptors, to the IDF. Concurrently, these industries are obligated to fulfil the demands of foreign clients, many of whom are involved in an arms race exacerbated by the ongoing conflict between Russia and Ukraine. Production for foreign clients is contractually bound by agreements signed before the outbreak of the conflict in Israel. These agreements stipulate preset delivery deadlines, and any delays could lead to significant penalties for Israeli companies. For instance, in addition to producing Arrow missiles for the IDF, the IAI manufactures Arrow 3 missiles for Germany as part of the largest defence deal in Israel's history, valued at approximately 14 billion shekels. Israel has not publicly disclosed its stockpile of interceptor missiles, whether involving Arrow missiles or those used in the Iron Dome system, which primarily intercepts short-range rockets launched from Gaza and Lebanon. However, unlike the production of Iron Dome interceptors, which are also finite, the manufacturing process for Arrow missiles is considerably lengthier.[21]

The Israeli industries are facing unprecedented production challenges to provide the IDF with more operational flexibility across multiple fronts. These challenges are compounded by the growing negative sentiment towards Israel globally, resulting in increasing difficulties in securing raw materials from international suppliers. These materials include various metals and unique electronic components that Israeli industries previously imported from foreign companies. Many of these suppliers, particularly in Europe, have adopted a selective approach, sometimes halting supplies entirely, especially for military-related materials. Israel's defence industries have had to devise solutions to counter these embargoes, many of which are unofficial or partially concealed. The IAI recently inaugurated a new facility in Ofakim to produce components previously imported from abroad, so as to overcome supply chain disruptions. However, such initiatives come at a significant cost, particularly with regards to time, an increasingly scarce and valuable resource given the high demand for defence materials in the current conflict.[22]

This issue has become more prominent in the current war, but there were early signs before the conflict started. High-ranking officials from Israel's legal,

political and security sectors had already expressed concerns beforehand. The 2014 report from the state auditor highlighted a significant concern regarding Israel's armament independence. Due to budgetary preferences, production lines were diminished and became obsolete, which adversely impacted the production capacity of light ammunition, tank and artillery munitions, as well as aerial munitions. Consequently, this situation rendered the Israeli defense industry unable to meet the requirements of the Israel Defense Forces (IDF), increasing reliance on American resources.[23] However, the lessons were not learned. In an article published in *Systems*, Major General Tamir Yedai, commander of the ground arm, highlighted how the situation worsened during major operations in Gaza, such as 'Operation Cast Lead' (2008–9) and 'Operation Protective Edge' (2014), where the IDF needed urgent equipment items.[24] This issue of emergency aid during a crisis has become politically controversial in the US, pushing Israel, which seeks to project an image of power, into a corner. Several years ago, this issue started to be examined in the chambers of Israel's political and security establishment. An initial document was written and submitted to Prime Minister Netanyahu, but the deep internal rift surrounding legal reform thwarted the clarification, which was only in its infancy. Additionally, in 2019, senior defence officials called for decreased dependency on the US.[25]

It is obvious that one year after the surprise attack on Israel, the country is facing increasing international pressure to stop its military operations. This pressure includes direct and indirect arms embargoes, and the relationship between Washington and Jerusalem has been strained. In response to these challenges, the Israeli public has called for a review of the nation's security doctrine.[26] In light of these developments, Israel and its defence establishment must thoroughly assess their strategic posture. A key part of this reassessment is the need to reconsider the role of US military aid, considering both its benefits and the potential vulnerabilities it creates. A major priority will be to rebuild Israel's military supply chains to ensure greater self-reliance and resilience. This will involve developing new stockpiles within Israel's borders, expanding domestic arms production capabilities and diversifying import sources to reduce dependence on any single foreign partner. These strategic adjustments are crucial for addressing immediate security threats and ensuring the nation's ability to recover and rebuild after the current conflict.

India's Defence Sector: A Strategic Lifeline in Crisis

Amid widespread global condemnation of Israel, India, a country that has long considered the Palestinian issue a central element of its foreign policy, has taken a more measured and balanced approach. For the first time in Israel's history of wars, India has condemned Hamas's terrorist attack.[27] Additionally, India's role has become increasingly significant for Israel's economy, especially in providing labour to make up for the loss of Palestinian workers.[28] However, the most critical development is India's shift to becoming a munitions supplier to Israel, reversing the traditional one-sided seller–client dynamic between the two nations.

New Delhi, a major arms importer from Israel, has become a crucial source of ammunition for the Jewish state during the recent crisis in the region. Adani–Elbit Advanced Systems India Ltd, a joint venture between Adani Defence and Aerospace and Israel's Elbit Systems, has played a key role in exporting munitions to Israel. These exports include Indian aerostructures, sub-systems and over 20 Hermes 900 unmanned aerial vehicles (UAVs)/drones. Additionally, the government-owned Munitions India Limited (MIL) has exported ordnance to Israel as recently as January 2024.[29] These developments marked a new direction in the relationship equation between the countries.

India has been a significant foreign customer for Israeli arms manufacturers. Although military deals only proliferated once diplomatic ties were established, the countries did have clandestine relations before 1992. For instance, Israel provided India with weapons in 1962 during the war against China; and then, in 1965, during the war against Pakistan.[30] By the early 1970s, the Indian military establishment was impressed and enamoured with Israeli technology. Following several interactions between military leaders in the early 1990s, India agreed to assign a defence attaché to Tel Aviv in 1995. In 1999, Israel provided India with urgent assistance in its conflict with Pakistan, establishing the country as a reliable military partner. Between 1997 and 2000, 15 per cent of all Israeli arms exports travelled to India. By the mid-2000s, this had increased to 27 per cent, with India broadening its range of purchases, such as surveillance equipment, drones and surface-to-air missiles. Between 2000 and 2010, India spent around $10 billion on Israeli arms.[31] According to Stockholm International Peace Research Institute (SIPRI), weapons deliveries to India from Israel increased by 175 per cent between 2015 and 2019.[32] In its recent 'surgical strikes' on Pakistan in 2019, India used Israeli-made 'Spice 2000' bombs.[33] In 2021, during the stand-off with China, India leased and finally bought four Heron TP medium-altitude long-endurance UAVs from IAI.[34]

The support provided by India to Israel's defence in the ongoing war illustrates the strategic role that the country could play in Israel's new security strategies. This support is in line with India's Make in India initiative for defence, which has also contributed to India's defence export objectives. In May 2024, reports indicated that India aims to increase its domestic ammunition production due to global shortages and rising demand.[35] Shortages of ammunition have been caused by ongoing international conflicts. Simultaneously, with Saudi Arabia and other Middle Eastern countries building up their ammunition stockpiles, there has been an increase in demand, leading to global scarcity of ammunition. India has started taking advantage of the opportunities arising from both these factors. The country's achievement results from a decade-long reform agenda to improve the ease of doing business and promote domestic production. These reforms and efforts to promote indigenous production have created an environment conducive to growth in defence output. As a result, there has been a significant increase in domestic production and defence exports, which reached Rs 21,083 crore in fiscal year (FY) 2023–24, marking a 32.5 per cent increase from the previous FY.[36]

In May 2024, the Indian Army significantly reduced its reliance on imported ammunition, in line with the Make in India policy, mainly due to the contributions of private companies. Previously, the army used to allocate 35–40 per cent of its annual ammunition budget of approximately Rs 20,000 crore to imports. However, this figure has now dropped to under 10 per cent, with further reductions planned. This movement towards indigenisation decreases dependency on imports and expands India's export capabilities. Both public and private indigenous firms are now catering to global ammunition demands. The MIL, a public sector company, and private firms, such as Solar Industries Limited, Adani Defence, Hughes Precision and SMPP Limited, have played crucial roles in this transformation. Notably, MIL has secured substantial export orders for artillery shells, fostering the development of supporting industries.[37] Additionally, a joint venture between Adani Defence and Aerospace and Thales (Belgium) has been established to manufacture and assemble North Atlantic Treaty Organization (NATO)-standard 70 millimetre (mm) (2.75 inch)-calibre ammunition currently used in Ukraine. The second phase of expansion at a 500 acre facility in Kanpur, located in the northern state of Uttar Pradesh, will include the production of medium-calibre ammunition for India's attack helicopters. This facility is now the largest integrated ammunition manufacturing site in South Asia.[38]

The changing geopolitical landscape presents opportunities and challenges

for India's defence export ambitions. Russia's invasion of Ukraine and the resulting sanctions have also impacted India's defence exports. In January 2022, India finalised a $375 million deal with the Philippines to sell three BrahMos supersonic cruise missile system batteries developed jointly with Russia. This export marked a significant milestone in India's efforts to establish itself as an arms exporter. However, there were delays in fulfilling this commitment, and the first batch was delivered in April 2024. This also had implications for the sales to Indonesia and Vietnam.[39]

Recently, India has transitioned from being a major arms importer to one of the top 25 arms-exporting nations, as per SIPRI.[40] India exports arms, ammunition and related items to over 85 countries, with 100 Indian firms involved in international sales. The notable exports include diverse items, such as the Dornier 228, 155 mm advanced towed artillery guns, BrahMos missiles, Akash missile system, radars, simulators, mine protected vehicles, armoured vehicles, Pinaka rockets and launchers, ammunitions, thermal imagers and body armours, along with systems, line replaceable units and parts and components of avionics and small arms. It is worth noting that most exports are driven by the private sector, while the state-owned defence production units have made limited contributions. However, most private sector exports consist of parts, components, assemblies and sub-assemblies, with only a few Indian companies exporting significant systems. Among the private sector exports, Bharat Forge's export of 155 mm artillery guns, valued at US$ 155 million, stands out.[41]

As mentioned earlier, the current geopolitical situation has positively impacted India's export capabilities amidst growing tension in the Middle East. The MIL, an Indian defence producer, has won a contract to supply artillery ammunition to the Kingdom of Saudi Arabia. In the World Defense Show 2024, Saudi Arabia placed a large order for 155 mm artillery ammunition. The signed contract is worth $225 million, making it MIL's most significant export order.[42]

As a non-traditional arms manufacturer, India faces numerous challenges that affect its ability to produce high-quality defence products. Partnerships with Israel, a country with significant expertise in arms manufacturing, could be the key to accelerating India's progress in closing this gap. Such collaborations also align with and strengthen the Modi government's Atmanirbhar Bharat (self-reliant India) initiative, advancing India's position as a significant arms exporter while addressing the technological needs of the Indian Armed Forces. Joint ventures and investments in defence manufacturing may serve as a critical solution to these challenges. Israel should embrace India's role as a major defence partner.

This alliance not only fortifies Israel's defence strengths but also amplifies India's technological advancements in missile and drone production. The ongoing evolution in high-precision guided artillery ammunition, driven by private and public sector initiatives, is poised to further elevate New Delhi and Jerusalem capabilities.

Today, major powers are increasingly conducting their conflicts through global supply chains.[43] India has the opportunity to position itself at the forefront of this power shift by becoming a key player in global arms shipments. The ongoing Iron Swords war has also created new prospects for India to strengthen its relationship with Jerusalem and gain more influence in international negotiations. The US should support these developments as part of its broader geopolitical strategy to counter Russia's influence in the global market. With Russia's capacity to meet market demands compromised by its invasion of Ukraine, endorsing India's increased role would be in line with the US' geopolitical objectives. By taking the necessary actions, both Washington and New Delhi can enable India to fill the void left by Russia in the global market, thus preventing China from doing so.

Israel's alliance with the US remains indispensable. However, following the war, a pivotal question arises: how can Israel reduce its military reliance on the US? One possible avenue lies in diversifying its strategic partnerships. While Israel cannot feasibly shoulder the costs of establishing a fully independent ammunition production system capable of meeting all the IDF's demands in a future conflict, it must continue to explore options for reducing its dependence on the US military aid. This can be achieved by increasing the production of weapons and ammunition; diversifying procurement through collaboration with other nations, such as Italy, India, Singapore and South Korea; and creating joint funds for shared weapons development and emergency reserves. By perusing these steps, Israel can ensure its autonomy in defence, even in times of conflict when American support may be limited. This will allow Israel flexibility in its offensive military response in a multi-arena campaign.

The defence collaboration between India and Israel in the ongoing war demonstrates a strong strategic partnership that significantly enhances both nations' military capabilities. This alliance not only strengthens Israel's defence capabilities but also boosts India's technological advancements in missile and drone production. It is important to note that while both sides focus on achieving self-reliance, it is crucial not to isolate the nation from global supply chains. Instead, efforts should

be directed towards leveraging domestic strengths and resources. India should achieve self-reliance by leading in specific sectors and establishing solid global partnerships in areas it lacks expertise. This approach involves excelling in domains where the West has relative disadvantages, while facilitating technology transfers in critical and emerging fields.

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PART VI

Policy Perspectives: Advancing Domestic R&D Capacity in Defence

17

India's Defence Aeronautics R&D Trajectory in 2025

Rajiv Kumar Narang

Introduction

Currently, the Indian aeronautics manufacturing industry appears very promising. It is pursuing a number of indigenous manned and unmanned aeronautics development programmes, including Light Combat Aircraft Mark-1 (LCA Mk-1), LCA Mk-1A, LCA Mk-2, LCA Navy Mk-1A, Advanced Medium Combat Aircraft (AMCA), Twin Engine Deck Based Fighter (TEDBF), Kaveri aero-engine, Tapas medium-altitude long-endurance (MALE) unmanned aerial vehicles (UAVs), Remotely Piloted Strike Aircraft (RPSA), Combat Air Teaming System (CATS), etc. All these programmes have their own nuances, challenges, limitations and opportunities.

The recently concluded 'Aero India 2025', a five-day event that was held at Air Force Station Yelahanka, Bengaluru, Karnataka, from 10 February to 14 February 2025, demonstrated India's growing capabilities and the promise for future. Indeed, the development of a number of fighters, trainers, transport aircraft, helicopters, UAVs, counter-UAV systems, radars, missiles, other sensors and payloads in the recent times, and the induction of some of them, reinforces the growing confidence in indigenous systems amid concerns of import dependence on critical components, sub-systems, sensors and payloads.

The observation of the Chief of Air Staff (CAS) during the air show in February

2025 regarding the slow rate of production of LCA by Hindustan Aeronautics Limited (HAL) amid delays in receiving GE-404 engines from the United States (US) highlights the perils of import dependencies and other challenges faced by the Indian industry.[1] The delay in the supply of GE-404 engines necessitates a review and revitalisation of indigenous aero-engine development programme. Further, the discontinuation or delays in the development of indigenous naval fighter aircraft development programme could have an impact on our self-reliance trajectory. These two indigenous development initiatives are most important and need to be progressed for certification and induction.

The promising trajectory of indigenous development of helicopters by HAL demonstrates the significance of persisting with indigenous development programmes despite challenges. However, depleting inventories of fighter aircraft, growing capabilities of adversaries, delays in indigenous development programmes, technology development challenges, as well as offers from the US, Russia and other technology leaders to supply fifth-generation fighters, advanced transport aircraft, UAVs, aero-engines, etc., are creating dilemmas for the decision makers. The biggest surprise came when China flew two advanced fighters, J-36 and J-50, in December 2024, which were described in the media as sixth-generation fighters.[2] This incidence highlights the need for India to review its approach to development and acquisition of fighter aircraft by the Indian Air Force (IAF).

India's indigenous fighter, transport and trainer aircraft, helicopter, UAV and aero-engine development programmes are in the crucial stage of development. The delay in decisions, indecisions, import in large numbers and transfer of technology (ToT) of aeronautics systems from foreign original equipment manufacturers (OEMs) can reduce availability of funds for acquisition from indigenous manufacturers, thereby impacting indigenous programmes.

This chapter provides a brief overview of the trajectory and challenges of indigenous aero-engines, as well as manned and unmanned aeronautics development programmes being pursued in 2025, and proposes a way forward to achieve self-reliance. Some suggestions on improving the conduct of Aero India at Bangalore are also briefly discussed.

Aero-Engines

The LCA Mk-1A, LCA trainer and AMCA fighter had a place of pride in Aero India 2025. However, the inability of HAL to deliver LCA Mk-1A amid delays in receipt of GE-404 engines highlights the vulnerabilities of import of aero-engines from foreign OEMs. This delay in supply emphasises the need for an urgent

review of the current approach, along with a refocus on overcoming challenges and expediting development and certification of indigenous engine. The Gas Turbine Research Establishment (GTRE), a Defence Research and Development Organisation (DRDO) laboratory, is currently focused on the development and certification of a non-afterburner variant, which is called the Kaveri Derivative Engine (KDE).

The design improvements, certification and induction of afterburner Kaveri engine need to be examined. This would enable the GTRE in validating critical engine technologies, components and sub-systems, whose knowledge would be useful for developing future indigenous engines. The afterburner variant of the Kaveri engine could also be used as power plant for the indigenous Hindustan Lead-in Fighter Trainer-42 (HLFT-42) aircraft.

Aero-Engine for AMCA: A Perspective

India is looking for co-development of a 110 kilonewton (kN) thrust aero-engine for AMCA. The AMCA is being designed around GE-414 aero-engine with 98 kN thrust. The effort is being made so that the proposed 110 kN engine has similar dimensions and does not require major design changes in AMCA. However, it has been seen in the past that the total weight of aircraft, especially the naval variant, becomes higher during the design phase due to various reasons. Therefore, there may be a requirement of developing an engine with higher thrust, say, 120–140 kN. The diameter of 120–140 kN engine would be larger, requiring redesign of the airframe. These design changes, if required, can be incorporated in the follow-on variants of the AMCA, TEDBF and LCA Mk-2 as the development of indigenous engine itself could take between 8–10 years.

Indigenous Naval Fighter

The naval fighter development programme has attracted less attention but needs much greater emphasis as lack of corrective measures at this phase could lead to need for import of naval aircraft, which is avoidable. The actions, inaction and delays in decision making in naval aircraft are detrimental to indigenous development and self-reliance trajectory. Some of the issues that need urgent attention are deliberated next.

LCA Navy Mk-1A

The LCA Navy Mk-1A, with approximately 13.5 tonne all-up weight (AUW), is unable to carry significant payload to undertake both air defence and strike

missions. The Indian Navy (IN), in the past, had Sea Harrier air defence fighters that had limited payloads. The former Chief of Naval Staff, Admiral Arun Prakash, a fighter pilot himself, had suggested that carrier-borne LCA Navy can be inducted to undertake air defence roles as well as generate valuable data for TEDBF.[3] The LCA Navy can also act as naval trainer and coast-based fighter with an ability to land over aircraft carrier for refuelling or in emergency. Further, it can use air-to-air refilling to undertake certain roles. However, the IN is yet to take a call on the induction of naval variant of LCA Mk-1A.

LCA Mk-2 (Navy)

The development of LCA Mk-2 for both the IAF and the IN was approved by the Cabinet Committee on Security in August 2022; however, the project funding was delayed, which was resolved in September 2023. The first prototype is expected to be developed by end 2025 and its first flight is likely to take place in 2028.[4]

The work on LCA Mk-2 had commenced much earlier when the learnings from LCA Mk-1 and LCA Mk-1A were used to articulate the requirement of a more powerful, more capable fighter with advanced systems. Similarly, learnings from LCA Navy were incorporated to propose the design for LCA Mk-2 naval variant. The development of LCA Mk-2 prototypes for the IAF is in progress; however, the IN has not given its consent for the development of the naval version of LCA Mk-2. As a result, further development of LCA Mk-2 naval variant has come to a standstill.

LCA Mk-2, AMCA and TEDBF

As just mentioned, the IN did not agree to join the development of naval LCA Mk-2 fighter and AMCA being developed by the Aeronautical Development Agency (ADA) and instead sought development of a new design 26-tonne AUW TEDBF aircraft. The decision to change from LCA Mk-2 (Navy) to TEDBF meant the development of an entirely new aircraft design, with requisite approvals that would add to the delay. In 2024, approximately Rs 15,000 crore was allocated for Phase-1 of development of AMCA, while the development of engine was to be pursued under a separate programme.[5]

The ADA had already made some progress in developing the naval variant of LCA Mk-2 comprising design changes in the tailplane, larger wings and modifications in engine to operate from aircraft carrier and undertake naval operations. The development of single-engine LCA Mk-2 (Navy) would have taken lesser time vis-à-vis a new aircraft.[6] This could have speeded up the induction

of the naval variant along with LCA Mk-2 of the IAF. If the IN gives its approval at this stage, the development of naval variant of LCA Mk-2 would take about 3–4 years and no fresh approvals would be needed.

Need for Separate Naval Fighter (TEDBF)

The quest for a separate naval fighter, that is, TEDBF, needs to be deeply examined considering that India has already approved the development of air force and naval variants of LCA Mk-2 and AMCA. The introspection is essential as many current fighter aircraft, like Rafale, F-35, MiG-29 and Su-33, have both air force and naval variants. This requirement of the IN, of a separate TEDBF, also creates administrative, financial and supply chain complexities. Further, it would have to go through the approval process again.

The AMCA with 25 tonne max AUW is of similar class as 26 tonne max AUW of TEDBF. In addition, AMCA is a five-and-half-generation stealth aircraft having fifth-generation as well as some sixth-generation fighter technologies, while TEDBF design is non-stealth (or has less stealth features due to its external weapon carriage and lack of internal weapon bay), which will provide greater survivability to AMCA vis-à-vis TEDBF. However, the IN has not yet acquired LCA Navy Mk-1 or joined LCA Mk-2 or AMCA programme. As such, the following issues merit deliberation:

- Is there a need for seeking TEDBF as a separate project considering that TEDBF and AMCA are of the similar weight category with maximum weight of 26 tonne and 25 tonne respectively?
- Is it not possible to develop a naval version of AMCA to meet the specific requirements of the IN considering leading global fighter aircraft have both air force and naval variants (such as Rafale, F-35, MiG-29 and Su-33)?
- Would not the fifth-generation AMCA (naval) with potential to integrate some of the emerging technologies (viewed by some as sixth generation), such as manned–unmanned teaming and artificial intelligence, be more versatile and better equipped to deal with Chinese fighters?
- Is it feasible for the IN to join LCA Mk-2 and AMCA development programmes, which have already been approved by the Indian government?

In addition, the development of more fighter variants, which include LCA Mk-1A, LCA Mk-2, AMCA and TEDBF, necessitates multiple supply chains and maintenance, repair and overhaul (MRO) facilities, which would have their own challenges and complexities.

Potential Impact of Import of Naval Fighter

The IN is pursuing the acquisition of 26 Rafale Marine (Rafale-M) fighter jets at an estimated cost of Rs 60,000 crore.[7] There are concerns that the import of these could have an adverse impact on indigenous TEDBF naval fighter aircraft development programme.[8] The number of fighter aircraft required for the two aircraft carriers of India is limited and the proposed acquisition of 26 Rafale-M, comprising 22 single-seat fighter and four twin-seat trainer jets, would meet the mid-term needs of the navy. It may, thus, obviate the need for indigenous development of TEDBF or AMCA. The funding available for indigenous programmes would reduce and this could make indigenous programmes unviable or uneconomical.

There may be a need for further deliberations to make a rational decision. However, the above-mentioned factors are important and need to be factored in while taking decision on acquisition and development of naval fighter aircraft. The lack of decision could disrupt indigenous naval fighter development trajectory and create unwarranted import dependencies.

China's Sixth-Generation Fighter Challenge

The induction of J-20 fifth-generation fighter aircraft and the first flight of J-36 and J-50 next-generation fighters by China in December 2024 not only surprised global aeronautics technology leaders but also created concerns in India. The J-36 and J-50 were described in the Indian media as sixth-generation fighters; however, there is no clarity on the technological advancements of J-36 and J-50 vis-à-vis current fifth-generation fighter aircraft.[9] The induction of China's fifth-generation aircraft and flight test of sixth-generation fighter aircraft in late 2024 have indeed changed the threat dynamic for India.

India, meanwhile, is exploring the acquisition of 114 Multi-Role Fighter Aircraft (MRFA), which is likely to be a four-and-a-half-generation aircraft. It would be prudent to examine whether MRFA be suitable to meet the threat that would be posed by Chinese advanced fighter aircraft. Also, the acquisition itself could take about 2–3 years for negotiation, testing and signing of contracts, and another 3–4 years for delivery to begin. The contract negotiations and acquisition timelines, envisaged operational life of three to four decades and effectiveness of MRFA against advanced fighters of potential adversaries needs to be factored in the decision making.[10]

On the other hand, the offer of Su-57 fifth-generation fighter of Russia and

F-35 of the US has added to India's dilemma on acquisition of fighter aircraft. China, in the times to come, could match or even move ahead of the Western and Russian fighter aircraft programmes, which will make acquisition of advanced fighters from foreign OEMs challenging. However, money for acquisition as well as for indigenous development would be out of the same capital acquisition budget head, which is limited. Therefore, import of fighter aircraft could have an impact on the availability of funding for indigenous fighter development programmes.

The development of AMCA Mk-2, with design modifications for sixth-generation technologies, could be launched to fill technology gaps. In addition, block approach is needed by freezing quality requirements (QRs) for the given block to improve production capacity.

Indigenous Trainers

The air display and customer demonstration sorties by Hindustan Turbo Trainer-40 (HTT-40) and Intermediate Jet Trainer (IJT) were aimed at demonstrating their suitability for arduous flying training role during Aero India 2025. The acquisition of HTT-40, which has already been cleared by the Indian government, will provide basic flying training to newly recruited pilots. The IAF has placed an order for the acquisition of 70 HTT-40 aircraft. Out of these, 10 aircraft will be produced at HAL Bangalore facility, while the remaining 60 aircraft will be produced at HAL Nasik facility. The delivery of HTT-40 is progressing as planned and the first aircraft is expected to be manufactured by the end of 2025.[11]

The IJT, also known as Hindustan Jet Trainer-36 (HJT-36), has been developed for imparting advanced flying training to pilots. It has been offered to the IAF and is likely to undergo operational trials in near future. The IJT, which was initially given the name 'Sitara', has been renamed 'Yashas' (glory), so as to dissociate from its past challenges and provide it a new identity. It may be recalled that the IJT had faced technical challenges in the past and had to undergo design changes to improve its spin performance. It had also faced challenges in optimum pressure recovery due to air intake design issues.[12]

Spin is the most challenging manoeuvre involving simultaneous roll, pitch, yaw with loss of height. The trainer aircraft is designed to train pilots to enter into spin and recover from it; and the IJT, with design changes, has demonstrated this capability. The HAL, after consultation with a global design house, has made necessary design challenges to improve the spin characteristics of IJT. Overcoming this challenge is an important milestone for the IJT that has paved the way for its induction as an advanced trainer.

The rigorous testing and certification of IJT has given confidence to HAL to offer it to the IAF for advanced flying training. The indigenous design of IJT, as well as the endeavour of HAL to manufacture IJT engine in India, further improves its viability for providing long-term support to users. In addition, it can be modified and upgraded to meet future advanced flying training requirements of the IAF and global buyers.

Indigenous Helicopters

Aero India 2025 did not have air displays by indigenous twin-engine Advanced Light Helicopter (ALH) and Light Combat Helicopter (LCH) due to ongoing investigation into the recent ALH crash. This is the first time that HAL took the difficult decision of grounding the ALH fleet to undertake deep analysis in order to identify causes and introduce corrective actions, if required. The grounding of aircraft is a normal practice followed by most aircraft manufacturers when they face technical challenges or undertake technical investigations. There are several examples of fighter aircraft developed by leading aircraft manufacturers of the world being grounded after crashes.[13]

Light Utility Helicopter (LUH)

The learnings from developing ALH helped HAL in the speedy development of LUH, a single-engine, 3-tonne-class helicopter, which took little more than a decade to obtain Initial Operational Clearance. The Acceptance of Necessity was accorded on 23 November 2021 and the Technical Evaluation Committee approval was accorded on 11 January 2023.[14] The Indian Army (IA) is likely to acquire about 225 LUH to replace its ageing Chetak and Cheetah helicopter fleets—though the negotiations are going on for 110 LUH and the total number may increase to 400 helicopters in due course. The initial procurement of 12 LUH, involving six each for the IA and IAF, is at the contract negotiation stage. [15] The IA is the lead agency for the procurement and LUH is undergoing testing and user acceptance flying.

Import, ToT and Lease of Helicopters

The grounding of ALH, the insistence of the IA on HAL meeting all the QRs of LUH and the visit of IA Chief to H125M helicopter manufacturing facility of Airbus in Marseilles, France, have generated discussion about leasing, import or ToT of similar category of helicopters in media. The H125M helicopter manufactured by Airbus is a renamed Eurocopter AS550 C3 Fennec. Airbus has

collaborated with Tata Advanced Systems Limited (TASL) to manufacture H125M in India; however, there is no clarity on the modalities, extent and timelines of local manufacturing of its critical equipment, materials and components in India.[16]

The LUH had undertaken customer and aerial demonstration flights for the stakeholders of defence forces, including the CAS, Director General Aviation of IA and the officers of IN, during Aero India 2025.[17] The induction of LUH would take place after its clearance by the IA. In the meantime, HAL is developing indigenous autopilot for LUH to replace the imported autopilot.

The long-term lease, import and ToT, particularly when indigenous projects have made significant progress, could have an undesirable impact on the self-reliance trajectory. Indigenous projects need honest effort by developers and handholding by users. Both need to work in tandem to ensure success of indigenous projects, which have several complexities. In other words, the success of aeronautics design and development projects depends upon the effort of all the stakeholders. The LUH is at the crucial phase and the stakeholders need to put their heads together to identify and address challenges and take measures to make it successful. Early induction would expedite further development and fine-tuning of LUH for operational employment. The HAL is also developing the Indian Multi-Role Helicopter to replace Mi-17 class of helicopters.

Indigenous Civil Trainer and Transport Aircraft

Hansa-New Generation (Hansa-NG) civil trainer aircraft and Saras transport aircraft are being developed by the Centre for Scientific and Industry Research's National Aerospace Laboratory (NAL). In addition, HAL has upgraded Dornier-228 into Hindustan-228, and also proposed the upgradation of Avro aircraft. The trajectory and challenges of development of Hansa and transport aircraft are examined next.

Hansa-NG

The two-seat, single-engine turboprop Hansa-NG civil trainer aircraft was displayed at Aero India 2025. Hansa has been under development and upgradation for a long time. It is being used by some flying training schools; however, it is yet to find international customers.

Hindustan-228

The HAL displayed Hindustan-228, which is an upgraded Dornier-228, at Aero India 2025. Hindustan-228 has new engine, advanced avionics, modern glass

cockpit, improved seats for passengers and other advanced features. However, Hindustan-228, unlike the under development Saras Mk-2, lacks the pressurisation to fly at high altitude. Therefore, it would be prudent to examine provision of fans, pilot window design improvements for better air circulation and other user friendly improvements for enhancing its attractiveness to global and Indian customers.[18]

Saras Mk-1 and Mk-2

The NAL's 14-seat Saras Mk-1 light transport aircraft with pusher turboprop engine configuration had carried out aerial display in Aero India 2023. There was plan to modify Saras Mk-1 and develop conventional puller configuration (Saras Mk-2). The pressurised Saras Mk-2 was aimed at replacing unpressurised Dornier-228 aircraft. However, there was neither static nor aerial displays of Saras Mk-1 or Saras Mk-2 in the Aero-India-2025.

The lack of focus on Saras project, which has made significant progress, could lead to losing out on significant design and development effort in developing Indian's first indigenous light transport aircraft. The early approval of the project is needed for moving forward in transport aircraft manufacturing in India.

Avro Upgrade for Self-reliance

The HAL has proposed upgrading its Avro fleet with new engine, avionics and airframe modifications. The IAF has significant number of Avro aircraft with adequate airframe hours and they can be upgraded with new engines and advanced avionics. The upgradation of Avro can provide much-needed experience of transport aircraft modification and upgradation to Indian engineers as well as increase the lifespan of the aircraft.

Road Map for Indigenisation of C-295

The TASL, in collaboration with Airbus, is building C-295, which is a replacement for Avro. However, it does not have the intellectual property rights (IPR) to manufacture more aircraft, and upgrade and develop future variants of C-295, on its own without the consent of Airbus, Spain. Both Airbus, Spain, and TASL need to be asked to propose a time-bound programme for local manufacturing of critical systems, upgradation and development of future variants of C-295. The TASL can also make its own road map for developing indigenous transport aircraft with or without the support of global OEMs with ownership of IPR.

Medium Transport Aircraft (MTA)

The IAF issued a request for information for the acquisition of 18–30 tonne MTA in December 2022. However, it is not clear if indigenisation of critical systems, software and materials was being insisted in the acquisition plan.[19] The lack of ownership and lack of emphasis on local manufacturing of critical systems, software, materials and MRO by Indian entities remains the weakest link in leveraging acquisitions for achieving self-reliance in transport aircraft manufacturing. There is a need for necessary course corrections in articulation of request for proposal and negotiations of contract for the acquisition of MTA and other aircraft to support self-reliance.

Indigenous UAVs

The CATS, Short-Range Unmanned Aircraft Vehicle (SRUAV, also known as Archer), Tapas and Archer-New Generation (Archer-NG) MALE UAV and RPSA are promising platforms having their own challenges.

CATS

The CATS is a multi-sensor, multi-shooter system that would be comprised of a mother aircraft, CATS Warrior, swarm UAVs, High Altitude Pseudo Satellite (HAPS), missiles and other systems as deemed necessary. The CATS Warrior, a low-observable unmanned combat aircraft vehicle developed by HAL, has attracted extensive media attention in Aero India 2025. The CATS Warrior will act as a loyal wingman to the manned fighter (mother aircraft). The CATS is a futuristic technology development initiative of the HAL that is evolving into a promising operational system. The operationalisation of CATS would require development and validation of several complex and enabling technologies that could have their own challenges and risks.

SRUAV or Archer

The single-propeller engine SRUAV, also known as Archer, was displayed outside the DRDO hanger during Aero India 2025. This is built on a proven airframe and proven engine, and is close to TB-2 class of UAVs. It has automatic take-off and landing (ATOL) capability and some sensors have been integrated into it. The development and integration of weapons is under progress. This UAV is suitable for operation by the IA, Indian Coast Guard and Central Armed Police Forces. However, lack of clarity on the concept of operations and lack of user involvement have been two key challenges in its operationalisation and induction.

The necessary course corrections are needed for its further development and induction.

Tapas and Archer-NG MALE UAVs

There were no full-scale models and aerial displays by twin-engine Tapas and single-engine Archer-NG MALE UAVs in Aero India 2025. Tapas has already demonstrated operations up to 28,000 feet altitude with 18 hours endurance. The induction of four and six Tapas intelligence, surveillance, target acquisition and reconnaissance (ISTAR) UAVs by the IAF and the IN, respectively, is under deliberation.[20]

The development of single-engine, twin-boom-armed Archer-NG MALE UAV is also progressing. The Archer-NG is expected to have payload capacity of about 300 kilogram (kg) and fly up to 30,000 feet altitude. The MALE UAVs are in the most crucial phase and decision on their induction is awaited. There is a need to focus on addressing their challenges and take measures for their early operationalisation and induction.

RPSA

The scale model of the flying-wing jet engine RPSA was displayed during Aero India 2025. The RPSA is a stealth combat UAV being developed by the Aeronautical Development Establishment (ADE), a laboratory of the DRDO. The small-scale model of RPSA, known as Stealth Wing Flying Testbed (SWiFT), had test flown on 1 July 2022.[21] The RPSA is proposed to be equipped with indigenous dry-thrust Kaveri engine. It could be employed for deep strike, electronic warfare and other high-risk, high-value missions. However, the approval for full-scale development of RPSA is awaited.

Need for Handholding by Stakeholders

Indian stakeholders, accustomed to acquiring fully developed systems, would need to understand the nuances of technology development, which has many facets and challenges. They would have to provide support and take difficult decisions at different stages to make indigenous CATS, RPSA, Tapas, Archer-NG and other indigenous development programmes operational, especially when they face challenges.

Aero India 2025

The five-day 'Aero India 2025' was held from 10 February to 14 February 2025. The first three days of the air show and exhibition were dedicated to business visitors, while the last two days were open to the general public.[22]

Aero India is a biennial air show and aviation exhibition that is held in Bengaluru. It is organised by the Defence Exhibition Organisation, Department of Defence Production, Ministry of Defence. The first air show was held at Air Force Station Yelahanka in 1996; and it has grown in size, scope and popularity since then.[23] It is India's premier aerospace and defence exhibition with back-to-back thrilling aerobatic flying displays by Indian and global aviation companies and the IAF.

Aero India 2025 had several distinctive features that made it special as well as challenging. It witnessed significant participation from the defence forces, industry, academia, innovators, start-ups, micro, small and medium enterprises, and other participants from India. The participation of potential buyers, sellers and collaborators from friendly foreign countries, in large numbers, indicated the hope, expectations and promise of Indian industry and brand India. The expectation of the foreign OEMs in selling advanced systems and establishing collaborations with Indian entities, and potential buyers in exploring acquisition of Indian equipment, made this a special event. The event also indicated an inclusive approach with the participation of senior functionaries and innovators from the IA, the IN and Headquarters Integrated Defence Staff (IDS), including those involved in innovations in aviation-related technologies.

Aero India is growing in importance due to increasing capabilities of Indian industry; however, there is scope for improving infrastructure and administrative arrangements. Therefore, suitable measures are needed to make Air Force Station Yelahanka a model aviation station with world-class infrastructure to host an event of such importance and magnitude.

Analysis

India has a long history of abandoning nearly developed technologies and systems when they face challenges. This has been one of the main reasons for the failure of many indigenous defence and aeronautics development programmes. The down-gradation, de-prioritisation and discontinuation of indigenous projects has been done on various grounds, for instance, likely obsolescence, fear of failure, offer of collaboration and ToT and need for leapfrogging, without understanding the

trajectory of technology development of certain complex systems and the impact of discontinuation. Often, deep technical reviews are not undertaken to identify the challenges and institute measures to make them successful. The lack of induction or induction of indigenous systems in limited numbers and their discontinuation has frequently taken India back to the drawing board, which needs to be corrected. A number of issues have been deliberated in this chapter and some course corrections have been suggested. In addition to those, the following need due attention.

The acquisition of a large number of aircraft from foreign OEMs, incomplete ToTs and licence manufacturing when indigenous development programmes faced delays or challenges were the three main reasons for disruption of indigenous design and development trajectory, which proved detrimental to self-reliance. For instance, the acquisition and local manufacturing of MiG-21, Mirage-2000, Jaguar, Su-30 and other aircraft did not contribute to self-reliance. Even where complete ToTs were obtained (for example, ToT of Avro), they were not utilised to fully indigenise critical components, undertake modifications and upgradations and pursue development of future variants.

The indecisions, delays and inactions by the stakeholders were other reasons for the failure of past promising indigenous development projects. Many past promising indigenous aircraft development programmes were abandoned due to challenges, while indecisions, delays and inactions prevented overcoming limitations of indigenous development projects. There was no consistency in efforts by stakeholders to go all out to address the challenges and limitations to make the projects successful. Also, key stakeholders responsible for delays, inactions and indecisions were not identified and held accountable.

In addition, pressure was put on the government to acquire advanced technologies from foreign OEMs when course corrections could have saved the day. For instance, the India, in the past, faced pressure to acquire advanced MiG-21. It may have been the requirement at that time, but the mistake was in its acquisition/ToT in large numbers against the indigenous Marut. A deep techno-financial analysis of the impact of large acquisitions on indigenous development could have saved the day. The delays, challenges and limitations of Marut were highlighted to acquire fighter aircraft from foreign OEMs, while wholehearted effort in overcoming limitations could've saved the Marut aircraft. The indecisions in addressing the challenges and lack of follow on program to upgrade Marut proved detrimental of its self-reliance journey.

Today, again, indigenous LCA Mk-1A, LCA Mk-2, AMCA, TEDBF, Saras Mk-2, HLFT-42 and Kaveri engine development projects are passing through a similar process, where they are facing challenges and struggles in development. The delay in supply of GE-404 engine for LCA Mk-1A (Tejas) and the higher cost of ToT of GE-414 engine for LCA Mk-2 are creating interruptions, which, though not exactly same as the denial of engine to HF-24 (Marut), has similar elements of delays, cost escalations, etc. The progress and challenges in upgradation of Orpheus 703 engine during the 1970s seem similar to the ones being faced in the development of Kaveri engine. Not continuing with the upgradation, certification and integration of afterburner Orpheus 703 engine, as well as further development and induction of future variants of Marut in large numbers, proved detrimental to the self-reliance trajectory. There is, therefore, a need for introspection and course corrections in certification and integration of afterburner Kaveri engine with manned and unmanned aircraft.

Further, an early decision on indigenous naval fighter aircraft development programme is required. If the IN decides to join development of naval variants of LCA Mk-2 and AMCA, it would have the certain advantages, namely: no requirement of separate approvals; reduction in fighter variant; and commonality of supply chains. The delays, inactions and indecisions regarding participation of the IN in indigenous aircraft development programmes could have an impact on the trajectory of indigenous development of naval fighters. Also, acquisition of a large number of fighters from foreign OEMs could have an impact on viability and reduce the availability of funding for indigenous AMCA, LCA Mk-2 and TEDBF fighter aircraft development programmes. All these need to be factored in while making decisions.

India's CATS, HAPS and other innovative UAV programmes, being undertaken by HAL, private sector companies and innovators, show immense promise in developing unmanned technologies in the country. However, these projects cover limited spectrum of UAV capability. The UAVs being developed by the ADE are facing some challenges while being close to achieving their full potential. These are promising projects that have to cross the operational induction threshold. The participation and ownership of users in Archer/SRUAV programme; overcoming challenges of Tapas and Archer-NG MALE UAVs; early approval of RPSA; launch of high-altitude long-endurance (HALE) UAV development programme; and development of enabling technologies, like unmanned traffic management system and indigenous detection and avoid system, would be critical for India to become self-reliant in UAV technologies.

In the transport aircraft segment, manufacturing of C-295 by TASL is the first initiative in India to enhance participation of private sector in aeronautics manufacturing. The C-295 is a replacement of Avro aircraft; however, the extent of ToT in C-295 is limited to production of 40 C-295 aircraft that are being acquired by the IAF. The TASL will require approval of Airbus for manufacturing additional aircraft. There is also a proposal for manufacturing maritime and electronic warfare variant of C-295.[24] However, the parent company, that is, Airbus, Spain, retains control over production, modification and upgradation rights of C-295.

India has received full ToT of Avro, which provides it freedom to modify, upgrade and develop its future variants. However, this option has not been exercised till date; and it is only recently that a proposal has been given for upgradation of Avro. There is a need to understand these nuances and differences. Therefore, a time-bound road map is needed for indigenisation of critical systems and modification and upgradation of C-295 in India with the participation of Indian entities. The TASL and other private sector entities may explore the viability of developing their own transport aircraft designs with IPR control; however, it would require support and commitment of users and handholding by the government. The Avro upgrade and further improvements in Dornier are essential to close the loop between licence manufacturing and indigenous development. The approval for the development of Saras Mk-2 needs to be expedited and the project needs to be made time-bound. The control over IPR, that is, having the power to modify, upgrade and develop future variants while building critical systems in India, would be critical to India's mission of self-reliance in transport aircraft manufacturing.

Conclusion

The emergence of China as a leader in developing advanced fighter aircraft and other defence aeronautics systems leaves India with a little choice but to become self-reliant. The import in large numbers, ToT or collaborations to meet immediate challenges, without obtaining core technologies and examining their adverse impact on indigenous development projects, has made India perpetually dependent on outside sources, which needs to change. The lack of self-reliance in critical aeronautics technologies could become a limitation.

Indian planners need to formulate a strategy and road map, with focused funding and timelines for indigenous development of defence aeronautics systems, for meeting the challenges that are likely to be posed by Chinese air power in the

next two decades. This would require addressing the challenges being faced by indigenous development programmes, as well as taking measures so that import, ToT and licence manufacturing do not impact the availability of funding for indigenous aircraft development programmes. Therefore, the following actions are recommended:

- Continue with the development and induction of CATS system being developed by HAL.
- Formulate road map with timelines, funding and user involvement for the development and induction of indigenous CATS, SRUAV, Tapas, Archer-NG and RPSA UAVs being developed by the ADE. Also, examine the need for launching HALE UAV development programme.
- Review and expedite design improvements, certification and integration of afterburner Kaveri engine with LCA fighter trainer and later with LCA fighter aircraft.
- Make plan with timeline and funding for certification and integration of KDE (non-afterburner variant) with LCA for validation of capabilities for integration with RPSA.
- Make a plan to establish high altitude wind tunnel and conversion of IL-76 or any other four engine transport aircraft into a flight test bed to overcome dependencies on foreign OEMs for testing and trials and prevent delays in indigenous aero-engine development programs.
- Review and examine development of 120–140 kN engine for AMCA and TEDBF. Also, examine the use of its derated variant for LCA Mk-2 and HLFT-42.
- Examine the need and make a plan for the development of AMCA-Mk-2 (or AMCA Block-2) and LCA MK-3 (or LCA Mk-2 [Block-II]) with indigenous engines and indigenously developed sixth-generation technologies.
- Examine induction of LCA Navy Mk-1/1A as carrier-borne air defence fighter, naval fighter trainer and coast based naval fighter aircraft.
- Review and resolve the need for a separate indigenous naval fighter development programme, that is, TEDBF, vis-à-vis aligning the indigenous naval fighter requirements with LCA Mk-2 and AMCA. Early decision is essential to prevent further delays in the development of indigenous naval fighter aircraft.
- Examine development of Avro Mk-2 with upgraded engine, avionics and other advanced systems to develop indigenous transport aircraft

manufacturing capabilities.

- Follow block approach for Hindustan-228 development and examine further improvements in pilot comfort and maintenance support for Indian and global market.
- Approve Saras Mk-2 light transport aircraft development programme and make it a time-bound programme with funding and user involvement.
- Make a road map for indigenous development of critical components, materials and software of C-295.
- Formulate a road map for modification, upgradation and development of Indian variants of C-295, with TASL having control over IPR.
- Include time-bound road map for local manufacturing of critical systems, materials, software and MRO by Indian entities in the MTA contract.
- Address ALH technical challenges on priority and take measures for early induction of LUH.
- Improve infrastructure for Aero India.
- Introduce 'Block Development Policy' for indigenously developed aircraft and systems in the Defence Acquisition Procedure (DAP) or other policies.
- The design for each block should be frozen and necessary certification completed before order for production of aircraft is given to obviate delays. The timeline for design and development for integration and certification of systems should be included in the production order.
- Introduce responsibility principle in DAP to enhance accountability of all stakeholders, including industry, in indigenous development and production programmes.

There is a need to take corrective measures to overcome the last-mile challenges faced in the indigenous manned and unmanned aeronautics and defence technology development programmes to truly achieve *atmanirbharta*. The organisational interests, ownership, motivated narratives, pressures from global OEMs and representatives of global OEMs in India, technology gaps, lack of information, etc., would continue to pose challenges.

The success of complex indigenous aeronautics and defence development programmes would depend on deep deliberations, honest analysis, decisive leadership and timely course corrections. The leadership would need to be equipped to handle pressures, take calculated risks, undertake reforms and make people accountable. Sometimes tough decisions may be needed to cross technology, narrative, administrative, organisational, policy and other barriers to achieve the challenging goal of self-reliance in aeronautics technologies through indigenous

research and development. The collaborations with global partners in niche areas should be beneficial for both without adversely impacting indigenous development programmes. A visionary, honest and courageous leadership at different levels is critical for achieving this ambitious goal.

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18

Private Industry R&D in Defence Sector

Ashis Bhattacharyya

Introduction

Research and development (R&D) plays a pivotal role in the advancement of technological innovation, especially in sectors that are critical to national security, such as defence. As India aims to assert itself as a global leader in defence capabilities, self-reliance in defence technology has emerged as a key strategic priority. This is especially important given India's long-standing reliance on imports to meet its defence requirements, accounting for more than 60 per cent of its defence procurement needs.

Over the past decade, India has made concerted efforts to encourage indigenous production through various initiatives, like *Make in India*, *Atmanirbhar Bharat* and the *Strategic Partnership Model*. A central element in this drive for self-reliance is fostering innovation and increasing the role of the private sector in defence R&D. Historically dominated by public sector entities, such as the Defence Research and Development Organisation (DRDO) and defence public sector undertakings (DPSUs), the landscape is now gradually shifting to encourage greater participation from private companies, start-ups and micro, small and medium enterprises (MSMEs).

This chapter explores the role of private industry in India's defence R&D sector, focusing on current trends, challenges, government initiatives and recommendations for improvement. It also provides a comparative analysis with global leaders in defence R&D, offering insights into how India can better position itself to meet global standards.

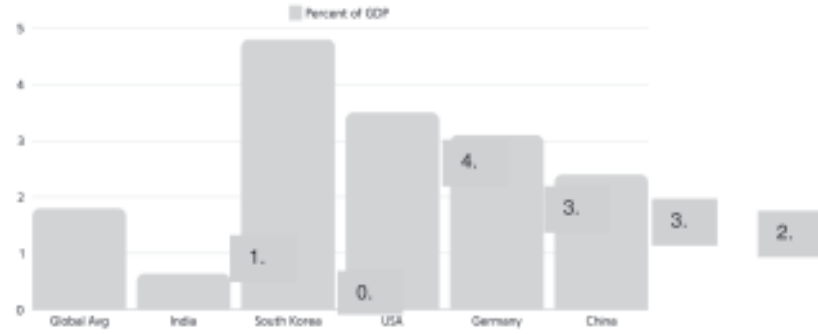
India's R&D Culture in General and its Comparison with Global Standards

India's R&D landscape, across all sectors, is still evolving. Currently, the country invests about 0.64 per cent of its gross domestic product (GDP) in R&D, a figure that is significantly lower than the global average of 1.8 per cent. This is in stark contrast to R&D powerhouses, like South Korea (4.8 per cent), the United States (US) (3.5 per cent) and Germany (3.1 per cent). These countries have recognised the strategic importance of R&D, not only in driving economic growth but also in strengthening their national security apparatus.

Global R&D Outlay Comparison

- ***South Korea***: The country leads global R&D expenditure with 4.8 per cent of its GDP allocated for R&D, driven largely by the private sector, which contributes over 70 per cent to the national R&D budget. South Korea's focus on high-tech industries, like electronics, aerospace and defence, has made it a leader in patents and technological innovation.
- ***The US***: The US invests about 3.5 per cent of its GDP in R&D, with the private sector contributing over 70 per cent. Major defence contractors, such as Lockheed Martin, Northrop Grumman, Boeing and Raytheon, are heavily involved in defence R&D, supported by extensive government contracts and partnerships with research institutions.
- ***Germany***: Germany's 3.1 per cent GDP investment in R&D is backed by a strong collaboration between academia, industry and government. The country's defence R&D is driven by companies like Rheinmetall and Airbus, with a particular focus on cutting-edge technologies, such as artificial intelligence (AI), cybersecurity and aerospace.

Figure 20.1: Global Comparison of R&D Expenditure as a Percentage of GDP 2022



R&D Expenditure in India

In India, gross domestic expenditure on research and development (GERD) is primarily driven by the government sector, including the central government (43.7 per cent), state governments (6.7 per cent), higher education institutions (HEIs) (8.8 per cent) and the public sector industry (4.4 per cent), with the private sector industry contributing only 36.4 per cent during 2020–21 (compared to the global average of over 65 per cent in leading economies). Of the central government funding, considerable allocation is directed towards autonomous R&D laboratories operated by the government. These laboratories serve a pivotal role in driving research and technology development with strategic implications.

According to the R&D statistics (2022–23) of the Department of Science and Technology, India's total investment in R&D reached US$ 17.2 billion in 2020–21. Within this, 54 per cent (US$ 9.4 billion) was allocated to the government sector and predominantly utilised by four key scientific agencies: the DRDO (30.7 per cent); the Department of Space (18.4 per cent); the Indian Council of Agricultural Research (12.4 per cent); and the Department of Atomic Energy (11.4 per cent). The remaining amount went to academic institutions and some R&D schemes for MSMEs and start-ups.

India's lower investment in R&D can be attributed to several factors, including lack of coordination between academia and industry, inadequate private sector participation, low-risk propensity and bureaucratic inefficiencies that slow down the innovation cycle. Adding to the woes is the fact that most of these funds remain underutilised due to complex procedures and bureaucratic delays (see Figure 20.2).

Figure 20.2: Underutilisation of R&D Funds, 2022–23 (utilisation %)

• Department of Biotechnology	72%
• Department of Science & Technology	61%
• Department of Scientific & Industrial Research	69%

Recent Initiatives

The recent enactment of the Anusandhan National Research Foundation Act, 2023 underscores the government's dedication to catalysing research and innovation as the cornerstone of development. The legislative move will potentially bolster scientific research nationwide. The act aims to bridge India's persistent R&D investment gap, while nurturing a robust research culture within the HEIs.

A draft National Deep Tech Startup Policy has also been promulgated, signalling a strong commitment to technological progress and innovation. Additionally, India's recent budget plan for 2024–25 includes a whopping Rs 1 lakh crore for improving research and innovation in the country.

In the defence arena, 25 per cent of the defence R&D budget has been earmarked for the private sector industries—a move aimed at catalysing the private industry to work in defence R&D.

Efficiency and Output Metrics

Despite its low investment, India ranks third globally in research paper production, with over 300,000 publications annually. However, when it comes to translating these academic outputs into patents and commercially viable technologies, India lags behind significantly. This gap between research output and innovation is a key challenge that needs to be addressed, especially in high-tech sectors like defence.

Table 20.1: Comparative R&D Investments and Outputs, 2022

Country	*R&D Funding % of GDP*	*Private Sector Contribution* (%)	*Patents/ Bn$ Rev*	*Pubs/ Bn$ Rev*
South Korea	4.8	76	240	37.9
US	3.5	70	200	50
Germany	3.1	67	210	45
India	0.64	36.4	7.3	88.5

Note: The table highlights India's need to bridge the gap between academic output and real-world technological advancements, especially in critical areas like defence technology, where innovation can have a direct impact on national security.

R&D in the Defence Sector: Global Comparison and Indian Perspective

Globally, defence is one of the most R&D-intensive sectors. Leading countries, like the US, China and Israel, invest heavily in defence R&D, both through government channels and private industry. As mentioned earlier, the US allocates over 3.5 per cent of its GDP to R&D, with major defence contractors, such as Lockheed Martin, Raytheon and Boeing, at the forefront of innovation in critical areas, like autonomous systems, AI and cyberwarfare.

Global Defence R&D Trends

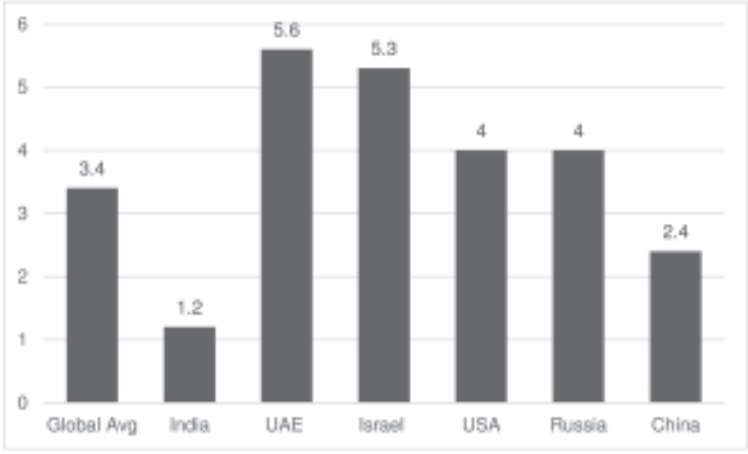
- ***The US***: The defence companies typically invest around 4 per cent of their revenue in R&D. The government plays a key role through the Department

of Defense and agencies like Defense Advanced Research Projects Agency (DARPA), which fund cutting-edge research in various fields, such as AI, space defence and cybersecurity.

- ***China***: The country's defence R&D spending is less transparent but is believed to be over 2.4 per cent of its GDP. The Chinese government works closely with state-owned enterprises, like Aviation Industry Corporation of China (AVIC) and China North Industries Corporation (NORINCO), to develop next-generation military technologies.
- ***Israel***: Israel is another global leader in defence R&D, allocating about 5 per cent of its GDP to defence research. Israeli companies, such as Rafael and Elbit Systems, are renowned for their advancements in missile defence, drones and electronic warfare systems. Israel's innovation ecosystem is bolstered by close collaboration between the military, private industry and academia.

In comparison, India's defence R&D spending is significantly lower, both in terms of government outlay and private sector investment. Indian defence firms, on average, invest only 1.2 per cent of their revenue in R&D, compared to the global average of 3.4 per cent.

Figure 20.3: Defence R&D Spending as a Percentage of Revenue (India vs Global)



R&D in the Indian Defence Sector

Public Sector Initiatives

India's defence R&D has been predominantly led by public sector organisations,

with the DRDO at the helm. The DRDO's budget for fiscal year (FY) 2024–25 was Rs 23,855 crore, which represents a steady increase in recent years as the government pushes for indigenous innovation. The organisation has been instrumental in developing critical technologies, like ballistic missiles, radar systems and fighter aircraft. It also collaborates extensively with other DPSUs, like the Hindustan Aeronautics Limited (HAL) and the Bharat Electronics Limited (BEL), to bring new technologies into the market.

Government Schemes

Several government schemes aim to bolster R&D in the private defence sector:

- *Innovations for Defence Excellence (iDEX)*: The iDEX scheme supports start-ups and MSMEs in developing defence technologies through grants and partnerships, fostering innovation to boost self-reliance in India's defence sector. By 2024, iDEX had signed over 350 contracts with start-ups working on technologies ranging from autonomous drones to advanced satellite systems.
- *Acing Development of Innovative Technologies with iDEX (ADITI)*: The ADITI scheme promotes disruptive technologies by facilitating collaborations between public institutions and private enterprises, so as to accelerate defence innovations for faster deployment. The start-ups under this scheme are eligible to a maximum of 25 crore for R&D and innovation.
- *iDEX Prime*: iDEX Prime supports high-value defence projects, offering grants up to Rs 10 crore for critical technologies, like AI and autonomous systems, to strengthen national security.
- *Technology Development Fund (TDF)*: The TDF, led by the DRDO, funds MSMEs and industries to develop technologies for the armed forces, encouraging collaboration with research institutions for indigenous innovation.
- *Supporting Pole-Vaulting in R&D through iDEX, Naval Innovation and Indigenisation Organisation (NIIO) and Technology Development Acceleration Cell (SPRINT)*: The SPRINT challenge is an initiative by the Indian Navy to promote indigenisation and innovation for maritime defence solutions via start-ups and MSMEs.
- *Rs 1 lakh crore for defence R&D*: The 2024–25 budget allocates Rs 1 lakh crore to bolster defence R&D, promoting private sector innovation and technological self-reliance.

- *Development-cum-Production Partner (DCPP)*: This initiative encourages collaboration between public sector units and private companies to co-develop and manufacture defence equipment.

Private Sector Investment in R&D

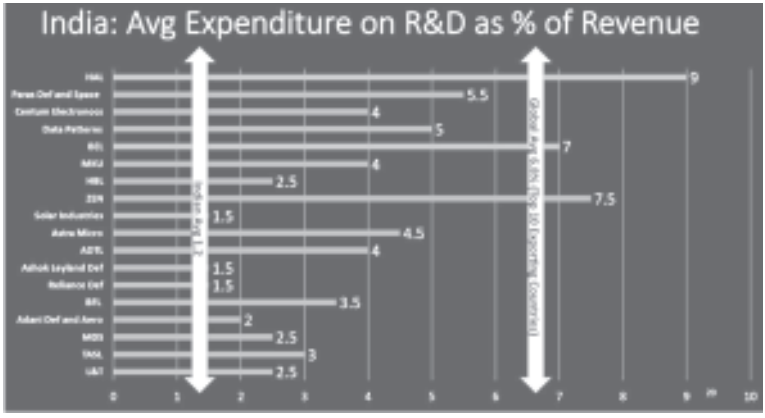
Despite the aforementioned initiatives, private sector participation in defence R&D remains relatively low. Large firms, such as Larsen and Toubro (L&T), Tata Advanced Systems and Bharat Forge, have made strides, but their overall R&D spending is still below global benchmarks. For instance, L&T, one of India's largest engineering conglomerates, spends only 1.2 per cent of its revenue on R&D. However, some industry experts claim that their R&D and D&D expenditure share of revenue are higher and are not reflected in financial documents due to lack of appetite for R&D among shareholders and investors.

Table 20.2: R&D Spending in Indian Defence Firms (FY 2022–23)

Company	*R&D Intensity (%)*	*R&D Spending (US$ million)*	*Number of Patents (2022)*	*PhD Employees (%)*
HAL	9.3	301	240	0.3
BEL	6.1	130	100	0.2
Bharat Forge	3.5	50	120	2.1
L&T	1.2	16	90	2.2

The investment by some of the top private industry players in the defence sector, as R&D intensity (per cent of investment as a percentage of revenue), is given in Figure 20.4.

Figure 20.4: India: Average Expenditure on R&D as Percentage of Revenue



Earmarking 25 Per Cent Defence R&D Budget for the Private Industry

In 2022, the Indian government announced that 25 per cent of the defence R&D budget would be reserved for private companies, start-ups and academic institutions. This move was seen as a game changer, particularly for MSMEs and start-ups, which now will have better access to funding and mentorship.

Recommendations to Improve the State of R&D in Defence

To strengthen R&D in India's private defence sector, the following strategies should be considered:

- *Increase private sector incentives*: The government should offer more tax incentives for private companies that invest in high-risk, high-reward R&D projects. This could include deductions for R&D expenditure, accelerated depreciation for R&D infrastructure and grants for early stage research.
- *Funding support for Make-I projects*: Increase government funding support in Make-I projects from the current 70 per cent to 90 per cent, as previously allowed under Defence Procurement Procedure (DPP) 2016, to incentivise private investments in high-risk R&D initiatives in strategic projects
- *Strengthen industry–academia collaboration*: The gap between academia and industry must be bridged to ensure that research is translated into commercially viable technologies. The *National Research Foundation (NRF)*, under the *Jai Anusandhan* initiative, should focus on creating innovation clusters that bring together universities, research institutions and private companies. Some other measures to foster industry–academia collaboration can be:
  - *Establish defence innovation hubs*: Create innovation clusters that connect academic institutions, research bodies and private industry, leveraging the NRF's resources to drive defence technology advancements.
  - *Encourage joint research projects*: Support collaborative research initiatives between Indian and international universities to address skill gaps and build capabilities in advanced defence technologies.
- *Talent development and skill building*: To address the shortage of PhD-qualified researchers in the defence sector, the government should expand fellowship programmes and offer scholarships for defence-related research. Collaborations with international universities could also help in building a skilled workforce.

- *Streamline procurement processes*: Start-ups and MSMEs often struggle with long procurement cycles. The government should streamline these processes under the iDEX initiative, providing clear timelines for converting prototypes into products and ensuring faster access to government contracts.
- *Enhance intellectual property generation*: Indian companies need to focus more on intellectual property creation. The government could offer incentives for patent filings and provide support for technology commercialisation.
- *Operationalise 25 per cent earmarked funding of private sector*: The announced earmarking of 25 per cent R&D funds for private industry needs to be operationalised at the earliest for incentivising niche research by private players. Any intention by interested parties of subsuming this announced fund under existing government schemes needs to be avoided.
- *Tax incentives for R&D expenditure*: Reinstate weighted tax deductions under Section 35(2AB) for defence R&D projects to stimulate private investments to pre-2015 status.
- *Tax parity between old and new companies*: The income tax for new and old companies should be at par, keeping in view that R&D creates new technologies and products that feed into 'Atmanirbhar Bharat'.
- *Promote indigenous content and production*:
  - *Production Linked Incentive (PLI)*: Extend the PLI scheme to the defence sector to boost investments in the manufacturing of critical technologies and systems.
  - *Incentivise higher indigenous content*: Provide additional financial incentives for projects achieving higher indigenous content beyond the mandated minimum, especially in strategic platforms, like aircraft, submarines and advanced weapon systems.
- *Encourage start-ups and MSMEs in defence R&D*:
- *Increase funding for iDEX and TDF initiatives*: Expand the iDEX and TDF programmes to provide greater financial support for start-ups and MSMEs, enabling them to undertake disruptive technology projects.
- *Simplify entry barriers for start-ups*: Reduce the compliance burden for start-ups participating in defence R&D projects, allowing for easier access to government contracts and funding.
- *Streamline procurement processes for faster commercialisation*:
  - *Adopt quality and cost-based selection (QCBS)*: For Make-I and Make-II

projects, move beyond the L1 (lowest bid) system by incorporating QCBS methodologies to emphasise quality and technical capabilities.
  - *Unutilised R&D funds under Centrally Sponsored Schemes (CSSs)*: Ensure re-routing of unutilised funds under government watch under CSSs, for private sector R&D and D&D purposes.

Possible Implementation Strategy

To effectively carry out these recommendations, the following can be examined for implementation:

- *Formation of a joint task force*: Constitute a task force comprising representatives from the Ministry of Defence, defence sector industry associations, like the Society of Indian Defence Manufacturers and the DRDO, and industry leaders to oversee the implementation of aforementioned recommendations.
- *Quarterly review mechanisms*: Establish quarterly review meetings with the Ministry of Defence to monitor progress and address any policy-level challenges in real time.
- *Streamlining approvals and clearances*: Develop a digitised, transparent approval mechanism to expedite project clearances and reduce bureaucratic delays.

Conclusion

India's private defence sector holds immense potential, but it has yet to fully realise its capabilities in driving innovation and self-reliance. While the government has introduced several initiatives to encourage private participation in defence R&D, more needs to be done to address existing challenges. By increasing private sector incentives, fostering industry–academia collaboration and developing a skilled workforce, India can build a robust ecosystem where the private sector leads in defence R&D.

With sustained government support and a concerted effort from private companies, India can emerge as a leader in defence technology, reducing its reliance on imports and enhancing its national security.

19

Advancing Domestic R&D Capacity in Defence: Role of Academia

Nabanita Radhakrishnan

Background

A nation's military prowess is based largely on its capacity to develop and exploit military systems, both defensive and offensive. There are two main ways to acquire these: either buy outright from friendly nations willing to share their military goods or develop these products and systems in-house, within the country. The pros and cons of buy versus indigenous capability have been debated and discussed extensively. Today, it is widely accepted that the first recourse to acquiring military equipment should ideally be through indigenous development, in order to protect from sanctions of seller nations and to develop and establish an indigenous military base.

In post-independence India, the Defence Research and Development Organisation (DRDO) was established, along with a network of ordnance factories and defence public sector undertakings (DPSUs), to provide production support for research and development (R&D). ix decades later, notwithstanding about Rs 4 lakh crore of indigenous production based on indigenous R&D, a revamped Ordnance Factory Board (OFB) and DPSUs, the fact remains that India is still one of the largest importers of military equipment. Hence, debate on the roles and deficiencies of concerned agencies continues, and the ecosystem therefore merits a review.

Let us start by looking at the evolution of a military product and the players involved in every stage of the game, with greater focus on those at the bottom of the pyramid, that is, the creators of basic research, which is indeed the foundation for R&D.

Players in R&D

There are three main players in the game of defence R&D. They are the DRDO, Indian industry and Indian academia. The DRDO was conceived as the R&D wing of the Ministry of Defence (MoD) and was tasked to design and develop cutting-edge systems for the armed forces. Today, with its network of about 40 laboratories (labs) working in diverse technology domains, it has over Rs 4 lakh crore of production based on its R&D to its credit.

The defence industry broadly consists of a state-run ordnance factory network and the DPSUs. In addition, a fairly strong private industry set-up, ranging from large and medium-scale industries to micro/mini, including a fledgling start-up ecosystem, is contributing to the ecosystem today. Indian academia has also been contributing its share. Starting from the establishment of India's first wind tunnel for aerospace systems in the Indian Institute of Science (IISc) over four decades ago, it today covers the top science and engineering institutions of the country. Thus, the framework for defence research appears to be quite diversified, with laid-out processes for inter-agency interaction.

R&D Categories Based on Technology Readiness Level (TRL)

A product development is taken up under various modes, depending on its TRL. In the United States (US), way back in the 1960s, the National Aeronautics and Space Administration (NASA) laid out its own standards of TRLs to gauge a product's expected development timeline.[1] These standards remain the founding block for development agencies, which either use this 'as is' or modified partly to suit their development style and modalities.

The DRDO too has mapped its technology processes to a modified TRL chart. Generally, TRLs 1–4 are reserved for academic institutions through various mechanisms and modes of funding. The TRLs 5–9 are handled by the DRDO mostly through its vast network of large industries and over 1,000 micro, small and medium enterprises, which have been nurtured over the last three decades to today's position of strength. There are, however, some exceptions to this broad rule. A few select science labs under the DRDO also work on basic research,

sometimes in association with academia and sometimes within their own premises. These include Solid State Physics Laboratory, which works on solid state electronics, and Defence Metallurgical Research Laboratory and Defence Materials and Stores Research and Development Establishment that work on materials. Most other science labs have drifted into product and technology development.

Today, the foundation of basic science/basic research in the country is firmly housed in Indian academia. The academia serves two broad purposes: educating and training the next generation of scientists in terms of graduating students; and serving as a hub for seeding and inculcating next-generation research through its faculty and research associates. They are a critical mass who will set the tone and tenor of futuristic defence technology and hence, their role and importance can no longer be underestimated.

Let us examine the universities involved in research and what are their areas of focus. At the topmost level are the Indian Institutes of Technology (IITs), the IISc, the National Institutes of Technology (NITs) and the Indian Institutes of Science Education and Research (IISERs).[2] Top-notch academic faculty with sufficient skills and a fairly well-established lab infrastructure make these the ideal and preferred node for seeding basic research programmes in defence systems. At the next level, a number of large private universities/academic institutions are present, including Vellore Institute of Technology, Manipal, Amity University, etc., which have, over the years, entrenched themselves as worthy proponents of cutting-edge research. Then, there are smaller and niche colleges and institutions in tier-2 cities which are rapidly growing and producing quality professionals in science and engineering. There is, therefore, a fairly extensive bouquet of institutions in the country. These institutions can become the cradle of continuous research in cutting-edge science, provided enough support and guidance is provided both in terms of financial support and outlining areas of requirement.

Role of Indian Academia Till Date in Indian Defence

Since the early 1980s, the DRDO, India's premier custodian of defence research, has put in place mechanisms to interact with Indian academia for assistance in its development projects.[3] These are at four levels:

- The first mechanism is the Contract for Acquisition of Research Services (CARS) placed by labs as part of their projects. These are very specific design/analysis packages or design vetting cases related to current projects, which have short timelines of 1–2 years and limited funding. The CARS—

basically a top-down approach based on specific needs—has been found to be very useful. It builds the first bridge between the DRDO and academia. Initially, it was restricted mainly to the IITs, but has now been extended to cover top academic institutions of the country.

- The second level of activity is through the DRDO Headquarters. The Directorate of Extramural Research has been set up to enable academia to delve into new areas which are generically connected to defence research. The main purpose is to draw universities into defence research. For this, rules and processes to award research projects to academia have been established. This mechanism is a bottom-up approach, enabling universities to seek funding for their research activity. The universities can forward proposals for design analysis in areas loosely related to defence requirements. One or more DRDO lab in the relevant field has been identified for coordinating and overseeing the activity. Over the past 30 years, a huge number of projects, invariably of low funding, have been awarded, of which only a few have been found to be useful. This has, therefore, not been a very successful model of operation.
- The third is the research boards. The DRDO has set up boards in four major areas of interest: aeronautics (1971); naval systems (1996); armaments (1997); and life sciences (1998).[4] These boards are a unique mode of research, with defined structures for oversight and guidance, and have brought in substantial input to development projects. Academic faculty and retired scientists steer these boards funded by the DRDO, by conducting research in academic institutions in futuristic areas.
- The Centres of Excellence (CoEs) constitute the fourth mechanism. Over a period of time, the DRDO understood that there was not much point in funding short-term, piecemeal research activities that do not yield sufficient output. Hence, it conceived the idea of setting up CoEs in specific areas for sustained funding and continuous research. The first CoE was established in 2005 at University of Hyderabad on high energy materials, followed by one at the IIT Madras Research Park in 2012. As on date, there are 15 DRDO industry–academia CoEs at various academic institutions across the country,[5] including IIT Kanpur, IIT Kharagpur, IIT Mumbai, IIT Delhi, Jadavpur University, IISc, etc. Each centre is headed by a DRDO scientist overseeing its functioning, while projects in the specified domain are allocated to concerned faculty experts, who are free to utilise students and research fellows to carry out the activity. The

DRDO scientists also participate in the research. Industry participation is through their HR, who work on product maturation and prototype development. A high-level committee reviews the milestone-based output and recommends further funding and research accordingly. This mechanism seems to be quite effective and the fruit of its output will be visible in the coming years.

In the recent past, Indian industry too has reached out to academia for assistance in specific projects for a defined and specified quantum of work. Today, the IISc and IITs are undertaking research analysis and design work for Indian private industry, which is indeed a welcome step.

Global Comparisons

To put the matter in its proper perspective, let us take a look at defence–academia linkages in a few select countries, namely, the US, the United Kingdom (UK), Israel and China. Together this quartet spans the linkage/control spectrum, ranging from very tight state military control in China, and even Israel, to a milder and arguably full freedom of choice in the US and the UK. Whatever be the kind of linkage, it is noteworthy that the academic centres of higher learning in science and engineering have always been contributors to a nation's defence capability in various forms, starting from basic research only and going right up to development of weapons systems in certain countries.

The US

In the US, there have historically been deep ties between the military and universities, through sponsored research, right from the days of World War II. Top-notch US universities, like Princeton, Berkeley, Columbia, Chicago, Johns Hopkins and Massachusetts Institute of Technology, have contributed to weapons system studies right from the days of the Manhattan Project, through the Cold War and onwards. Today, the list of Department of Defense (DoD)-funded University Affiliated Research Center (UARC) labs include the top 15 best institutes of the country working in key areas, such as nanotechnology, applied physics, space dynamics and tactical autonomy.[6] In addition, universities can apply for DoD grants/funding even if they do not have defence labs within their campus, albeit with restrictions on security and confidentiality.

Sometimes research is done as huge group projects, with different universities handling a specific part of the problem, which allows the best brains to collaborate

in their niche expertise domain. In addition to the DoD, private defence firms also rely heavily on universities, first, to absorb top students from top colleges and second, to fund research for their defence contracts. Technology firms also partner with top universities, as also with regional co-located colleges, to set up courses in emerging technology areas of interest.

The UK

In the UK, military and defence firms treat universities as their extended arm. Some postgraduate and doctoral programmes are designed in line with the MoD requirements.[7] An example is the tie-up of Thales and QinetiQ with University of Exeter for electromagnetics. Other collaborations include: University of Bristol and BAE–Thales for confidential research projects; Leeds University with Rolls-Royce for submarine systems diagnostics; University of Sheffield with Boeing in advanced manufacturing techniques; and University of Bristol with Leonardo, QinetiQ and Rolls-Royce for a master's course in aerial robotics. The largest involvement in defence appears to be of University of Bristol and University of Birmingham, with King's College, University of Nottingham, Cambridge University and Glasgow University following close. International partnerships also exist: an example is University of Surrey with Lockheed Martin for protection systems in armoured vehicles.

While there is some moral concern on the close academia–defence linkage, it is justified by the fact that this has provided employment/training to many students in advanced systems, in addition to financial support for academic research. It is noteworthy that in Britain, most defence tie-ups are between defence firms (not government agencies) and universities directly, thus leading to an immediate translation of basic research into products.

China[8]

In China, the state recognises the crucial role of universities and considers it as one of the three arms of its science and technology innovation system. It is a well-planned state controlled system with research institutes working on technology breakthroughs and system development, while defence conglomerates focus on commercialisation and large system development, leaving frontier research to the universities. The Chinese government also awards scholarships to high-achieving students to join the defence sector.

The Seven Sons of National Defence is a group of top universities of China

with deep ties to the country's military; indeed, it is more realistic to label them as defence universities than civilian ones. It includes: Northwestern Polytechnic University; Harbin Institute of Technology; Beijing Institute of Technology; Harbin Engineering University; Beihang University; Nanjing University of Aeronautics and Astronautics; and Nanjing University of Science and Technology. These universities are also a major source of human resource to the defence conglomerates and high-tech firms (Huawei, ZTE, etc.) as they are hired directly to work on modern warfare systems, like missiles, aircrafts and military electronics. In addition, these universities are among the best funded ones, and about half of their academia and budget is focused on defence research.

Further, the State Administration of Science, Technology and Industry for National Defense has signed agreements with a number of universities, including Tsinghua and Peking University, to work on focused areas in defence, such as material science and armaments. Depending on their specialisation and achieved success, the labs can be converted into prestigious defence labs within the university. An example of this is the University of Electronic Science and Technology of China (UESTC) in Chengdu. The UESTC has a number of labs dedicated to defence research in areas related to electronics and optics; signal processing and anti-jamming technology; radar-absorbing materials; etc. Over the last few years, international partnerships have also been encouraged. For example, in 2016, the UESTC, in collaboration with the University of Glasgow, established a joint college in China that offers degrees in electronics. It also runs the Joint Fibre Optics Research Centre for Engineering with the University of New South Wales in Australia. Other examples include: Beijing Institute for Aeronautical Materials (BIAM)–University of Manchester Graphene Aerospace Material Centre; Aviation Industry Corporation of China (AVIC) with Imperial College, London, on aircraft structures; and Sino-British centre on control systems between University of Manchester and China Academy of Launch Vehicle Technology (CALT).

It is evident that the Chinese government has a far-sighted vision, which focuses not just on defence requirements of today but also looks deep into the future. Almost every aspect of future defence requirements has been kept in mind while seeding technology incubation centres in major universities, coupled with deep oversight and constant reviews, thereby building up not just an extensive technology base but also a rich human resource base for the future.

Israel

Israel is a country that has constantly been at war with one or other of its enemies/border nations. Having to live in a constant state of war has shaped the lives of Israelis like no other country in the world and hence, every agency that can be utilised in this endeavour has been drawn into the defence sector. Israeli academia is no exception. While every new technology and product developed is put to use by the military, the country simultaneously prepares for the export market through its arms industry.

Collaboration with the arms industry includes universities, such as: the Technion in Haifa; the Weizmann Institute in Rehovot; the Hebrew University; the Ben-Gurion University; and the Tel Aviv University.[9] By far, the leading university is Technion University, which can be considered as the R&D arm of the military. It has not only helped to develop the D9 remote-controlled bulldozer, but during 2008–13, it also had a research partnership with Elbit Systems Ltd—one of the largest Israeli weapons companies—in electronic detection devices. In addition, Technion has developed other technologies and systems, an example of which is the 'Scream', a 'non-lethal' acoustic system that 'creates sound levels that are unbearable to humans at distances up to 100 meters'. The Bar-Ilan University too has participated in joint research with the army, specifically in developing artificial intelligence for unmanned combat vehicles, and it has also supplied drones to the Israeli Army. Thus, it is seen that the Israeli academia has actually worked directly in defence system development, and not just basic research, and has links with both the arms industry and government labs.

An Ideal Cycle of Interaction

A glimpse of the international scenario indicates a full spectrum of collaboration in certain countries, ranging from isolated basic research to full-fledged weapon system development. In India, however, most interactions with academia have been majorly through the DRDO, with isolated interactions being initiated by Indian industry in the recent past. Let us take a look at what should be the ideal cycle to obtain optimum output in India.

In the past, national labs have tried to do everything themselves: from basic research in their science labs to technology and product development in their technology labs to, sometimes, limited production in their system labs. This was required earlier when both industry and academia had not yet established themselves as niche players in their respective fields. However, today, with an

established industrial base and an accomplished academic pool, there is a need to rethink on the cycle of product evolution.

Every product has a typical cycle of evolution, starting from basic research ideally, which should have been carried out much earlier as sponsored research by academia. The basic science should then be converted into a technology by addition of hardware and perhaps related software. This should preferably be carried out at labs/industry which have the requisite infrastructure. Once preliminary testing and proving of the technology hardware is completed, it is time to hand over to the industry for packaging; ruggedisation and perhaps integration with allied sub-systems; and testing of the product/system as per initial specifications. Handholding of the industry by national labs during this phase may be required depending on the complexity of the system. This will also ease the process for industry to take up full-scale production after user acceptance.

Further upgrade or follow-ups should only be carried out by the production agency exclusively, taking assistance from developer, if required. The next generation of basic research, which should not just be an incremental improvement but should ideally be a generation leap, should then be taken up by academia either on its own or sponsored by the national labs/agencies. There is, thus, the need to have neat spheres of work and a hand over from one stage to another seamlessly, so as to get maximum output from niche expertise players, rather than try to do everything by a single agency not quite skilled in all aspects.

Some Issues in Defence Research within Academia

Indian academia has been actively involved in defence research projects, at least for the last two to three decades. However, its roles and operations have largely been dictated on an immediate need basis, and proper technology seeding for futuristic programmes has not been systematically taken up. Today, there exist certain issues which have to be resolved if effective output is to be obtained. These are:

- There is confusion on the roles currently played by academia and the DRDO. In the recent past, there have been suggestions from various quarters for academia to be involved in product development and the DRDO to concentrate on basic research in futuristic technologies. This would be a very detrimental initiative as academia's forte lies in translating textbook material into lab tangibles, which can only be carried out by them and none other. Similarly, the DRDO has the wherewithal to translate

research into prototypes and this should continue to be their forte.

- There are problems regarding intellectual property rights (IPR). Sometimes, there is confusion on who controls copyright/patents/papers which are sponsored/funded by another agency. This may create problems in academia as publishing papers and seeking patents is their fundamental work ethos. There is also the issue of security implications in military system development, which may hamper publishing. The common understanding currently in vogue for sponsored research is that IPR are joint and explicit permission needs to be sought/given if it is to be published.
- Academia linkage with defence may cause problems in international collaboration with other foreign universities. Sometimes foreign universities are bound by their governments to restrict interaction with academia which is involved in defence research. This may cause roadblocks in academia interactions.
- There is a need to focus on research, in addition to conducting academic courses and paper publishing. In India, there is greater focus among faculty and research scholars on publishing papers while carrying out their academic workload of taking classes. There is, therefore, a need to mandate that research be a part of the workload so as to inculcate research bent of mind among academicians.
- Outdated equipment/infrastructure Some universities continue to use outdated equipment for their research/lab activity. This needs to be improved. There is a need to build up state-of-the-art infrastructure in the relevant field if it is to serve as a long-term technology hub. A large part of the funds received should be devoted to installing the best of its kind test and analysis infrastructure.

Recommendations

Based on the foregoing discussion and keeping in mind the intrinsic role that academia can play in defence research, following are some key recommendations:

- There is a requirement to have more than one university carrying out research in a particular area, or have a hub with participation of more than one institution in a specific domain, so as to involve greater expert collaboration. Issues of operationalising will need to be worked out.
- Basic research is time-consuming and painstaking and requires continuous and not intermittent funding. Funding agencies must liberalise their funding policy to enable this aspect and not expect too much output too

soon or an immediate return on investment (ROI).

- There must be a portal that reveals the ongoing research activities to interested parties, namely, national labs, the Indian Space Research Organisation, the DRDO and the Department of Atomic Energy. A network connecting strategic technology organisations was to have been set up, whose current status is not clear. This could perhaps be revived. This network could then disseminate knowledge on ongoing research, which will enable wider utilisation and cut down on duplication.
- Indian industry should invest more on basic research in academia as they transit more and more into next-generation product development. Exposure of their personnel to hardcore science through interactions with academia will result in better technology appreciation and absorption.
- There is a need to upgrade and reskill manpower working in national labs and industry. This must be a continuous process, with batch after batch systematically going through the process, so as to enhance the technology human resource base in the country. Postgraduate and doctorate studies by the lab and industry personnel should be encouraged, albeit in the agency's area of interest. This should be done both by labs and industry who are seeking research services from academia. Specialised courses catering to futuristic technologies should be initiated by sponsoring agencies.
- It is necessary to enhance the quantum of funding on basic research. Every agency involved in developing defence products should put aside at least 10 per cent of its research budget for seeding basic research in academia. Only then will the fruits of labour be available on a sustained basis for futuristic technologies.
- Academia should work mainly on raw science/basic research. There is no need for academia to get into weapon system development per se as there are enough agencies to cater to this area. Only fundamental science, in terms of materials, control systems, electronics, etc., needs to be focused upon, which will enable dual use and protect against security constraints in global interactions.

Conclusion

Presently, Indian defence research is at crossroads, with a great deal of scrutiny on the roles of various agencies. There is a crying need to demarcate roles and responsibilities of the various players in the game and provide reassurance of sustained funding and support as R&D cannot be carried out as an 'on/off' activity

operating under the Damocles sword of funding cut-off or ROI. Once these basic tenets are understood and put in place, Indian defence research will surely rise to greater heights, with synchronised patronage of academia, the DRDO, industry and the armed forces.

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PART VII

Protracted Wars and Sanctions: Mitigating Risks in Defence Resource Management

20

Navigating Protracted Wars and Sanctions: Mitigating Risks in Defence Production

Jayant Patil

Introduction

Recent times have seen multiple protracted military conflicts and violence in West Asia, Eastern Europe, and one brewing in East Asia, along with increased terror insurgencies. All these have seen the increasing use of disruptive technological weapons, as also deployment of low-cost autonomous systems where volumes make up for precision. Economic and trade sanctions have been imposed on nations indulging in such acts, not only to dissuade them economically but also disrupt their supply chains, so as to bring them to the discussion table. Unfortunately, also visible are friend-shoring initiatives and collaboration between like-minded nations on both sides, to sustain the war efforts.

In today's era of technological evolution, no major nation can afford to be dependent for its security lest it suffer from '*Denial of Use*' of capability from remote. Thus, it is imperative for India to be self-reliant in key strategic sectors, including Defence and Aerospace. In addition, as a country facing hostile neighbours, India is highly exposed to impending war-like situations and has to fight on multiple fronts, namely, safeguarding the borders with war-ready & capable armed forces; fighting insurgencies and acts of terror; running cyber operations and safeguarding satellites from hackers; balancing geopolitical postures through diplomatic channels; maintaining political balance; and drawing friend/enemy lines with a focus on safeguarding the welfare of the people of the nation. To

build robust and resilient capability, the country needs to provide contemporary and emerging technological weapons to the armed forces. In addition, it is essential to produce critical sub-systems domestically and sustain these capacities in manufacturing so that they can be scaled up to endure a war of attrition. Such capabilities need to address multi-domain warfare in all five domains, that is, Underwater, Surface, Land, Air, Space (including Cyberspace & Information warfare), as also introduce autonomous, unmanned systems that can enable remote operations. Today, Artificial Intelligence is transforming and disrupting everything and the war domain is not an exception. Remote and unmanned domains call for autonomy on hardware (need to be our own with no hidden circuitry) and software-driven systems to enable enormous flexibility and adaptability from mission to mission, and thus unlimited advancement in capabilities can be achieved which is restricted solely by the ability to innovate.

Opening up of Sector and Incremental Reforms

By the beginning of the twenty-first century, the Government of India (GoI), committed to build a robust domestic defence industry, thus opened up the sector for unrestricted private sector participation. It also initiated major reforms towards democratising Defence Research and Development (R&D) as well as production. From opening of the sector in 2001 by an act of the Parliament and licensing it in 2002, the defence procurement procedures evolved from the 'Secret Guidelines' of 1992 to a structured framework under successive Defence Procurement Procedures (DPPs), beginning with DPP 2002 with a focus on 'Buy' to bring in efficiency in defence procurement. The procurement procedure evolved incrementally into: DPP 2003 (Buy & Make with imported technology); DPP 2005 (Offsets); DPP 2006 (Make); DPP 2008 (Offset banking and bringing in transparency in trials); DPP 2011 (Buy & Make [Indian], Enhancing indigenous content to 50 per cent, Foreign Exchange Rate Variation (FERV) for Buy [Global] contracts, civil aerospace offsets); DPP 2013 (Prioritising Indigenous Acquisition categories, Indigenous Content definition, access to Long Term Integrated Perspective Plan); and DPP 2016 (Indigenously Designed, Developed and Manufactured [IDDM], Strategic Partnership Model [SPM], Enhanced Performance Parameters [EPP], increased indigenous content and offsets threshold). The latest was the Defence Acquisition Procedure (DAP) 2020, which mandated increase in Indigenous Content [IC], further strengthening the framework of Innovations for Defence Excellence (iDEX), as well as introduction of Project Monitoring Units and process for resolving post-contract matters.

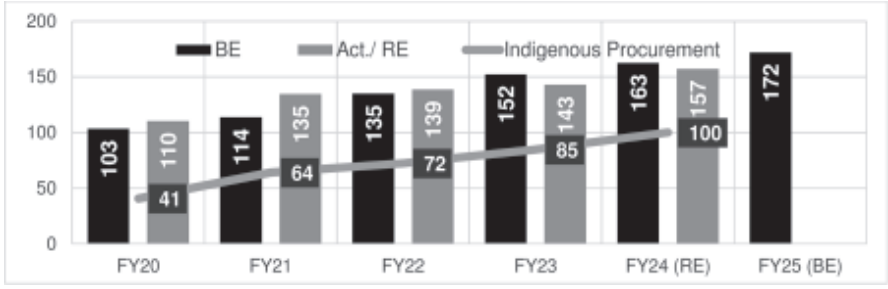
Impetus to Reforms

Besides, in 2018, the GoI launched Technology Development Fund (TDF) and iDEX initiatives, and continued further to introduce iDEX Prime, Swavalamban and Acing Development of Innovative Technologies with iDEX (ADITI) schemes, to build a robust domestic defence ecosystem. The Indian government also: operationalised two Defence Industrial Corridors (DIC); Corporatised Ordnance Factories (OFs); announced five Positive Indigenisation Lists (PILs); implemented Public Procurement (Preference to Make in India) Order 2017; created 'SRIJAN' portal; reformed Offset Policy to attract investment and Transfer of Technology (ToT); and announced democratisation of Defence R&D by stipulating allocation of '25 per cent of R&D funds to industry, start-ups and academia'.

State of Defence Industry

India has come a long way from being the world's largest arms importer in 2000 to entering the list of top 25 arms exporters in 2022. The focus on defence exports has enhanced India's capability and accordingly, defence exports have grown multi-fold from Rs 686 crore in 2013–14 to Rs 21,083 crore in 2023–24. The GoI has been continuously increasing the defence budget, with special focus on indigenisation, in particular with the introduction of 'Make in India' initiative in 2014. Further, post-Galvan stand-off, the GoI has been focusing on reducing import dependence and ensuring '*Atmanirbharta*' in equipment/systems for the armed forces.

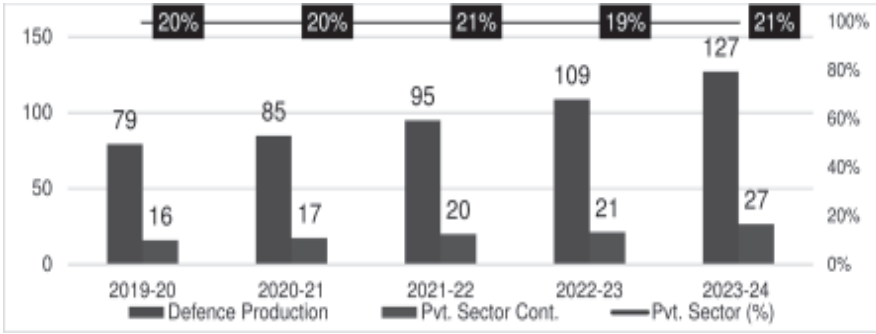
Figure 23.1: Defence Capital Budget Trend



Note: All figures are in '000 crore'.

Source: BE/Actual/RE – Capital Outlay on Defence Services MoD Budget (Demand No. 21) of respective financial year
Indigenous Procurement – Union Budget Summary by MoD PIB of respective financial year

Figure 23.2: Defence Production



Note: All figures are in '000 crore'.
Source: DDP Dashboard (https://ddpdashboard.gov.in/defence-production)

In spite of various GoI major initiatives towards self-reliance in the defence sector post opening in 2001, such as reforms in DPP (2002 onwards till 2020); Raksha Udyog Ratna (RUR); introduction of 'Make' Acquisition category; creation of TDF; encouragement of enhanced Indigenous Content; dedicated defence industrial corridors; corporatisation of Ordnance Factory Boards (OFBs); and introduction of iDEX scheme etc, Non-level playing field between the defence public sector undertakings (DPSUs) and the private sector prevails. As a result, defence production in the private sector has stagnated at around 20 per cent of total domestic defence production. Figure 23.2 represents the data of last five years and shows that the contribution by the private sector in defence production has been between 19–21 per cent. It has also been observed that a large share of the contracts (by value) are awarded by the Ministry of Defence (MoD) on 'nomination' basis, thus providing only 26 per cent opportunity to private sector to compete. As defence industry is considered to be shaping in slow motion (due to its nature and public money being involved in spend), the benefits of IDDM, 'Make' and No-Nomination policy are yet to yield results.

With respect to performance on defence exports front, the contribution of about 60 per cent by the private sector gives confidence that it has the capability to design, develop and manufacture equipment/systems as per global standards. Accordingly, with this backdrop MoD has set new targets for domestic defence production of Rs 3 lakh crore and defence exports of Rs 50,000 crore by 2028–29.

Major Initiatives towards Indigenous Capability Development and Analyse

It is crucial to analyse 'What went WRONG??' in the existing initiatives/policies which have not yielded the desired results. While many of the liberalisation initiatives were path-breaking in concept and approach, there have been gaps in implementation/operationalisation. It is important to take stock of how these and other reforms have performed to different degrees of success, as also many other reforms that were conceptualised and evolved through policy papers but did not get implemented. Some of the major initiatives have been: Defence Production Policy 2011, which later evolved into Defence Production and Export Promotion Policy (DPEPP); Professionalising Acquisition; reforms in EXIM procedures for Defence Lines of Credits (DLoC's); implementation of Project Management Unit (PMU); and Directorate General of Quality Assurance (DGQA) reforms. The main point to consider here is that after all the policy reforms and government's positive intent, why has India continued to be one of the largest importers of defence hardware; and this is despite the focus, since early 1990s, to be self-reliant in critical hardware and technologies. To understand this, it is important to review the status of key major initiatives of the GoI which are being celebrated as success at large.

RUR—Champions like DPSUs

Based on the recommendation of Vijay Kelkar Committee of 2005, granting of RUR status to selected private sector companies for building major defence platforms, like tanks, aircraft and frontline warships, was initiated. The selected 15 private companies (post evaluation by competent committee) were to be granted the status of RURs/equivalent to DPSUs, thus ensuring a level playing field, including reimbursement of 80 per cent of R&D expenses, total exemption of excise and favourable treatment on custom duties. An Empowered RUR Committee evaluated the applicant companies and shortlisted 11 private majors to grant RUR status in 52 categories. However, in 2010, due to pressure by the DPSUs/OFB trade unions, and contestation by the MSMEs, the GoI scrapped this path-breaking initiative to build a robust private defence industry for major platforms, quoting that the inclusion of 'Buy and Make (Indian)' category in DPP 2008 obviated the requirement for RURs.

SPM

In 2015, SPM was recommended by the Dhirendra Singh Committee to build long-term capabilities. Subsequently, the process for selection of private sector companies as strategic partners was detailed by a task force under V.K. Aatre, with inclusion of DPSUs only in case of exceptions. The SPM was introduced under capital acquisition category in DPP 2016. It envisaged developing domestic private defence capabilities in four segments of fighter aircraft, submarines, helicopters and armoured fighting vehicles/main battle tanks. However, only two major programmes in this model were initiated: (i) Naval Utility Helicopter (NUH) in February 2019; and (ii) P-75(I) programme (submarines) in June 2019. The NUH programme has been cancelled due to various reasons. One of the main reasons is that the state-run Hindustan Aeronautics Limited showed interest in participating in the programme, which was contested by other private majors who felt that the SPM was introduced for development of only domestic private defence industry. Currently, this leaves only the P-75(I) programme progressing using the SPM, where an Expression of Interest (EoI) was issued to three private players and two DPSUs. In the evaluation process, one private and one DPSU company have been further shortlisted, which is against the intent and spirit of creating this acquisition category. Thus, the SPM is also going down the RUR path, without launch of any new development programme over the past eight years.

iDEX and iDEX Prime Schemes

The iDEX initiative provides grants up to Rs 1.50 crore (up to Rs 10 crore for iDEX Prime) to start-ups and MSMEs for projects in various technological areas. This scheme, launched in April 2018 with a focus on indigenisation and R&D in defence technology, aims to encourage self-reliance and indigenisation in Defence & Aerospace (D&A) sectors. It targets projects from start-ups and MSMEs which have high innovation potential, despite low capital investment. Funding to the Defence Innovation Organisation for implementing the iDEX scheme focuses on three key functions: co-innovation; piloting technologies; and indigenising defence and aerospace platforms through ToTs. In addition to iDEX and iDEX Prime, other schemes that have been launched by the GoI are as follows:

- Mission DefSPACE (financial support up to Rs 10 crore in space mission).
- iDEX4Faujis (financial support up to Rs 1.5 crore for innovation by armed forces).

- iDEX SPRINT (financial support up to Rs 10 crore for innovation in naval technologies driven by Swavalamban).
- ADITI (financial support up to Rs 25 crore for critical and advanced technology with defence and export potential).

The iDEX scheme has been granted a budgetary support of Rs 498.8 crore, for the period 2021–22 to 2025–26, to provide financial assistance to around 300 MSMEs and start-ups. Further, as ADITI scheme was launched in March 2024, budgetary support has been revised to Rs 750 crore from 2023–24 to 2025–26. However, the status of complete iDEX scheme grants is approximately Rs 410 crore (approved for 465 number of challenges), which is minuscule. Further, only development of elemental technologies is possible by this level of funding and no major product/platform technologies/system of systems development is feasible under this scheme. This scheme has achieved the modest growth so far, however this scheme was celebrated more which raised lot of hope, than the results achieved.

TDF

This scheme was launched in September 2016 (with financial support from the Defence Research and Development Organisation [DRDO] up to 10 crore, which was extended to Rs 50 crore in 2022–23) with the aim to create an ecosystem for promoting self-reliance by building indigenous advanced technologies (emerging or futuristic) for defence applications by participation of private industries, especially MSMEs and start-ups. Taking into consideration technological solutions by the industry, the conventional tendering process was modified, and quality and cost-based selection (QCBS) was also adopted to give the required weightage/preference to technical and technological aspects. However, the current status of this scheme is not very encouraging as only 78 projects, at approximately Rs 333 crore, have been sanctioned. The funding's under this scheme may be appropriate for products/small systems development, but not conducive for major products/System of Systems/Platforms. The Kakodkar–Saraswat Committee was constituted to suggest suitable mechanisms after raising funding limits. However, 'No New Projects' have been conceived/accorded Acceptance of Necessity (AoN) under the enhanced financial powers (up to Rs 50 crore per project).

25 Per Cent of Defence R&D for the Academia, Industry and Start-ups

In the annual budget for 2022–23, it was announced that 'defence R&D will be opened up for Industry, Start-up and Academia & 25% of the defence R&D

Budget has also been earmarked for this purpose'. However, so far, no standard operating procedures or firm guidelines have been issued by the MoD or the Ministry of Finance (MoF) to gauge the progress in this regard. The DRDO, which took ownership to implement the reform, began accounting spend on DRDO's Development Partners (existing practice since founding of DRDO) towards implementation of the reform in letter but not in spirit. The Kakodkar–Saraswat Committee also dwelt on implementing this reform. However, the issuance of procedure for allocation is still awaited.

Public Procurement (Preference to Make in India) Order 2017

This order was issued by the Department for Promotion of Industry and Internal Trade (DPIIT), in 2017, to encourage domestic production through public procurement. The policy prioritises procurement (purchase preference of 20 per cent) of products and services with higher indigenous content (minimum 50 per cent) in government procurement to boost domestic manufacturing and reduce import dependency. The order defines the supplier category based on level of indigenous content:

- Class-I Supplier: > 50 per cent indigenous content; and
- Class-II Supplier: 20–50 per cent indigenous content.

This order was implemented by MoD only for procurement by the DPSUs. Further, MoD implemented this for reserving procurement from MSME in RFP's values below 50 crore under 'IDDM', 'Buy (Indian)' and 'Buy and Make (Indian)' categories. This impressive and important DPIIT policy to boost defence manufacturing is only partially incorporated in DAP 2020.

Make-I Category of Acquisition for Co-funded Design and Development

Based on the recommendation of Kelkar Committee, the 'Make' category of acquisition was introduced in DPP 2006 to: encourage the participation of private sector in defence R&D; and align the focus of DRDO towards projects requiring complex, strategic and sophisticated technology. This category of acquisition was conceptualised for Outsourcing of R&D work of high technology to private sector with sharing of cost and assured Minimum Order Quantity (MoQ) for financial viability of development within the scheduled time. There are various reasons for impeding this initiative, such as: Development cost share (80:20 changed to 90:10 and then to 70:30 with 250 crore limit); Requirement of 'Unconditional Compliances to the Provisional Staff Qualitative Requirements' parameters; Development Agency (DA) selection procedure (30:70 weightage of development

and production cost for products to be developed); Criteria for DA selection (Non-implementation of Quality and Cost Based Selection [QCBS]/ T1–L1 as suggested by the MoD across government procurement); 'Fear of Failure' to fund development in Private Enterprise; Very Long Acquisition Timelines etc. The status of 'Make-I' procedure is not encouraging and till date, only 44 projects have been initiated (at various stages: Approval in Principal (AIP), feasibility study, AoN, EoI and Project Sanction Order [PSO]); and it is only for two projects that PSO has been issued in the last 15 years.

Defence Testing Infrastructure Scheme

This scheme was launched in May 2020 (with Rs 400 crore outlay for setting up of six to eight Greenfield Defence Testing Infrastructure facilities) with the aim to create state-of-the-art testing infrastructure in partnership with industry. Financial support (grand-in-aid) up to 75 per cent was to be provided by the government and the remaining 25 per cent of project cost was to be borne by Special Purpose Vehicle (SPV), the constituents of which were to be private entities and state governments. As the scheme had the requirement of an SPV to be registered as a Section 8 company, is not encouraging the industry to indulge into the scheme. Hence, no major infrastructure has been created under this scheme in the last four years. Model correction is yet to be initiated in spite of known limitations, while testing delays galore - delaying qualification and acquisition by MoD, as also exports.

Quality Assurance (QA) Reforms

The aim of these reforms was to institutionalise the culture of transferring quality responsibility to Indian original equipment manufacturers (OEMs). However, many of the needed reforms are yet to be implemented, such as:

- Level the playing field for indigenous OEMs vis-à-vis foreign OEMs, that is, compliance-based acceptance of goods.
- Indian OEMs to be the Authority Holding Sealed Particulars (AHSP) for 'IDDM' and 'Make' cases, with intellectual property rights (IPR) ownership remaining with Indian OEMs. Also, enabling force multiplication through spiral development, enhanced performance parameters and planning and implementing obsolescence management.
- All trial agencies and QA/quality control directorates to be under one entity (User Service/Designated office), taking accountability of delays and cost overruns.

In addition, Green Channel Certification (GCC) scheme was launched in 2017 and till date, about 30 GCCs have been issued to 11 companies for more than 30 products and spares (minuscule in percentage terms). Further, AHSP policy for 'IDDM' and 'Make' cases was issued in August 2023 with reservations from industry, No Indian OEMs have been granted AHSP status till date. As recommended by various experts, reforms in QA procedures and organisation structure are critical for speedy execution.

Provisions Yet to be Exercised

Various forward-looking provisions were introduced in DAP 2020, after detailed deliberations. However, some of these provisions are yet to be exercised/ identified gap in implementation:

- *Single party acquisition under IDDM*: DPP-2016 introduced this category for acquisition, if indigenous capability (unmatched) exists in single respondent after Request for Information (RFI) stage/ Multiparty RFP to encourage indigenisation. Prerequisite is to have a minimum of 50 per cent indigenous content and the proposed solution shall be critical to National Security. However, observed dilution of the acquisition category from 'IDDM' to 'Buy and Make (Indian)' is rampant, even at the cost of continued foreign dependence, to uphold competition. Also, forgiven the dilution for majority of nominated acquisition from DPSUs.
- *Enhanced performance parameters*: These parameters were introduced in DPP 2016. However, they were not being implemented until recently, for incentivising acquisition of force multipliers.
- *Reimbursement of cost escalation due to inflation*: This provision was introduced in DAP 2020. However, it has not been exercised in most RFPs with larger contract tenure; arbitrarily fixing > 3-year contract tenure (while the MoF stipulation is only for 1 year).
- *Miscategorisation between Make-I and Make-II*: Platform-level programmes are being categorised under Make-II (against the intent for creation of separate categories for development) to avoid ownership of shortlisting DA and avoiding funding under Make-I.

Recommendations

It is imperative for the Indian armed forces to be battle-ready, especially in the current geopolitical scenario. The country needs to focus on sustenance of domestic

defence ecosystem in the volatile environment of protracted wars and sanctions. There is, thus, a need to focus on the following:

- Dispassionately reviewing the results of, and gaps in, initiatives undertaken by the MoD.
- Identifying and bridging the gaps in implementation.
- Adapting the model from developed countries for rapid creation of domestic defence industry.
- Investing in indigenous IPR creation and production, including basic electronic hardware, together with chips and software.
- Creating a robust domestic defence ecosystem.
- Developing capabilities in design, development and manufacturing of sub-systems—critical to autonomy.
- Ensuring sustainability of domestic defence industry through defence exports and domestic production.

Conclusion

Sustenance of domestic defence ecosystem is means to building dependable supply chains with ability to scale at short notice. This calls for sustaining production at critical level to be able to scale up quickly using innovative thinking, modularity in design, engineering & production and achieve building the Military Industrial Ecosystem. Such an approach and developing dual-use technologies that can leverage the strengths of both civil and military sectors, promoting innovation, economic development and national security. This cannot be achieved without engaging the industry in planning for defence needs in long run, to be able to develop capabilities within the country through Civil–Military Fusion (CMF) model to achieve both the ability to scale at short notice as also do it competitively. Adaptation of the CMF model, as done by developed nations, has been recommended in different forms. The RUR to build indigenous product capability through 'Make' programmes; level the playing field for industry across public and private sectors; and increase the contribution of private sector in defence production (which has remained in the range of 18–20 per cent), all have been recommended by multiple expert committees in the past. These reforms, however, remain to be embraced wholeheartedly. Further, overly focusing on 'one-time procurement' of matured products and platforms leaves little room for spiral development through continued innovation and celebrating early successes in various small initiatives, most without ability to scale.

Over the years, the Indian defence industry has matured from component manufacturer to becoming system of systems integrator through own intellectual property, which is vital for the ability to export. This is visible from the fact that, currently, more than 85 per cent AoNs are granted under indigenous acquisition categories, as also by the stellar growth in exports, led by private enterprises. Towards building self-reliance and sustenance for protracted war situations, we need to review current models, draw conclusions and institute innovative models to embrace industry for building capabilities by leveraging dual-use technologies.

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21

Navigating Protracted Wars and Sanctions: Mitigating Risks in Defence Resource Management

Abhay Dayal

Introduction

In the current geopolitical scenario, the capacity of a state to wage a war for a prolonged period of time would depend, to a large extent, upon the economic and military might at its disposal. Therefore, a time period-based definition of the phrase 'protracted war' may not provide a realistic understanding of its implied meaning. Any war would appear to be 'protracted' for the affected nation if it has to dip into its war reserves and is in a situation where maintaining the fighting potential of its armed forces becomes a challenge. It can thus be safely assumed that a protracted war in the Indian context would imply a non-nuclear, conventional military war with an adversary(s) for a period exceeding six to eight months.

India's war experiences, post-independence, have been of relatively short wars. The 1962 Indo-China War lasted 33 days; the 1965 war lasted one-and-a half-months; the 1971 war lasted only 14 days; and the Kargil conflict lasted just short of three months. As a result, stocking planning of war-like stores has been aligned to maintaining the war reserves for a limited and short duration war. Sustained military operations, on the contrary, are bound to throw up challenges in logistics, equipment and technology supplies. For instance, the 1962 Indo-

China War exposed India's inadequacies in terms of military preparedness and dependence on foreign suppliers. Similarly, the 1999 Kargil conflict, though localised and fairly short, brought out the importance of long-term strategic resource management.

Over the years, it has been realised that indigenous defence manufacturing and procurement are fundamental and mandatory components of a nation's security apparatus. These activities ensure that the armed forces are equipped with advanced weaponry and cutting-edge technology essential for maintaining deterrence and capability superiority in conflicts. However, the process is fraught with challenges, especially during protracted wars and under the imposition of sanctions. In an era marked by geopolitical tensions and protracted conflicts, the management of defence resources, particularly in terms of manufacturing and procuring weapons and equipment, plays a pivotal role in national security strategies.

Sanctions as a Tool of Statecraft

Direct warfare is not always the primary tool in today's world. Economic and diplomatic sanctions have increasingly become central to weakening adversaries, without actual physical engagement, and are being regularly used by states as a tool of statecraft to influence the behaviour of other states towards achieving their own diplomatic goals. Sanctions, whether imposed directly on a country or its defence partners, can have a far-reaching impact on that country's defence resource management.

Since the advent of the twenty-first century, military experts have been professing that the future wars would only be 'short and intense'. However, the Russia–Ukraine war and the Israel–Palestine conflict have stretched beyond anybody's imagination. This would have surely forced the proponents of 'short and intense wars' to recalibrate their hypothesis. Despite the considerable drain on the warring states' resources, exacerbated by the sanctions imposed by the United States (US) and the European Union (EU), Russia and Ukraine have continued operations relentlessly for over three years. Interestingly, in 2023, Russia was facing three times the number of sanctions imposed on any other state in the world (with Iran at second place) and the numbers have only grown since then.[1]

In a future scenario, sanctions, whether imposed directly on India or on India's defence partners, can have a far-reaching impact on our defence resource management. The case of US sanctions under Countering America's Adversaries

Through Sanctions Act (CAATSA) against Russia, a major defence supplier to India, exemplifies the challenges of maintaining operational readiness amid external constraints. Sanctions on other countries, such as Iran, have also impacted India's energy security, indirectly affecting its defence preparedness.

With India topping the world's list of arms importers for many years now,[2] a deeper insight into the effects of such protracted wars and sanctions imposed on the nation's defence resources surely merits examination.

India's Defence-related Foreign Dependence: An Overview

India's dependence on foreign states for its defence capability requirements began in the 1950s, with the procurement of fighter aircraft for the Indian Air Force (IAF) and its first aircraft carrier (*Hercules*, later renamed as *INS Vikrant*) for the Indian Navy (IN) from the United Kingdom (UK).[3] This was followed by a series of major procurements from the erstwhile Union of Soviet Socialist Republics (USSR), in terms of helicopters and MiG fighter aircraft for the IAF and tanks for the Indian Army, in the late 1950s and throughout the 1960s. The overt military hardware support to Pakistan by the US during the Cold War era further intensified the closeness in military and overall diplomatic ties between India and the USSR.

In the 1970s and the 1980s, the list of Soviet-origin equipment in the inventory of the Indian Armed Forces further grew with the induction of the air defence guns, missile systems and armoured fighting vehicles into the newly raised Army Air Defence and Mechanised Infantry regiments. The IAF purchased MiG fighter aircraft, Mi-17 helicopters and AN-32 and IL-76 aircraft for its transport fleet. The IN also procured a submarine, *INS Sindhughosh*, and received technical assistance for its submarine programme. One prominent exception to this was the procurement of Mirage-2000 aircraft from France.

The disintegration of the USSR, followed by the recovery of the Indian economy in the late 1990s, saw a shift in the stance of the US towards India. Simultaneously, with the advent of the twenty-first century, India began exploring options of importing arms and equipment from foreign sources other than Russia. Presently, the major states on which India depends on for its military imports include the US, France, Russia, Israel, South Korea, Poland, Ukraine and South Africa. Russia still remains the leading arms supplier, accounting for almost 36 per cent of Indian arms imports. France and the US are at second and third place with 33 per cent and 15 per cent of the share, respectively.[4]

Currently, India is collaborating with several countries in the arena of defence. These strategic partnerships are being attempted beyond mere outright procurement of combat hardware. The focus has shifted towards technology transfer, co-development and co-production. The 'buyer–seller' relation of the past is slowly but steadily giving way to a status of 'collaborator'. India's agreements with France for the Rafale jets, with Israel for missile systems and with the US under the Defence Technology and Trade Initiative (DTTI) are examples of successful collaborations that will enhance India's indigenous capabilities, while ensuring access to critical defence technologies.

India's Experience with Sanctions in the Past

India faced its first major sanctions in 1992, when its request for cryogenic engines for its space programme was not approved by the US,[5] citing violation of the Missile Technology Control Regime. The second instance when India faced sanctions from around 14 countries was when it conducted its second series of nuclear tests in May 1998.[6] Interestingly, these sanctions were also imposed on Pakistan when the latter conducted its own nuclear tests following India's tests. The US justified the imposition of the sanctions by stating that they were required to be applied by law, in accordance with Glenn Amendment (Section 102) of the larger Arms Export Control Act of 1994, which necessitated the application of the same in case any non-nuclear weapon state detonated a nuclear explosive device.

The Sanctions and their Impact

The sanctions imposed on India by the US Department of State in June 1998 were widespread and included the following:[7]

- Terminated or suspended foreign assistance under the Foreign Assistance Act, with exceptions provided by law (for example, humanitarian assistance, food or other agricultural commodities).
- Terminated Foreign Military Sales (FMS) under the Arms Export Control Act, and revoked licences for commercial sale of any item on the US munitions list.
- Halted any new commitments of US government (USG) credits and credit guarantees by USG entities, including EXIM Bank and Overseas Private Investment Corporation.
- Executive order issued to prohibit US banks from extending loans or credits to India and Pakistan governments.
- Denied export of all dual-use items controlled for nuclear or missile reasons.

Takeaways from the Past

Interestingly, experts have been ambivalent about the economic impact the above-mentioned US-led sanctions had on India at that time, let alone on India's defence infrastructure and preparedness. The reasons for no major economic impact were considered to be: India's relatively insulated industrial ecosystem; and its healthy foreign currency reserves position.[8] The two main reasons for a muted impact of these sanctions on India's defence sector were:

- *Short-lived sanctions*: The sanctions, at that time, were relatively short-lived and were lifted to a large measure by the Clinton administration as early as 6 November 1998 itself, with the remainder being revoked by the USG in 2001. Thus, the complete long-term impacts of the prohibitions put in place by the US were hardly able to manifest. However, the same may not be the case in present-day scenario should India choose to engage in a protracted conflict, the impact of which is directly or indirectly inimical to US interests.
- *Less dependence on US arms*: In 1998, India's dependence on US arms and defence equipment was miniscule, but presently, this inventory has increased. The country has contracted several weapon systems and equipment from the US over the last 25 years. It is, therefore, imperative for Indian policy and decision makers to factor in these developments during strategic decision-making processes.

Impact of Ongoing Wars and Sanctions

It is essential to also take a look at the impact of ongoing major conflicts in the world and their related international sanctions on India's defence resource management.

- *Impact on arms and equipment sourced from Russia*: The adverse impact of Russia–Ukraine war on India and the likely impact that it can have towards sustenance of the Russian-origin weapons and equipment can be gauged from the joint statement issued during the 22nd India–Russia Annual Summit held at Moscow on 8–9 July 2024, where this aspect was included. The statement said:

  Both Sides agreed to encourage joint manufacturing in India of spare parts, components, aggregates and other products for maintenance of Russian origin arms and defence equipment under Make-in-India program through transfer of technology and setting up of joint ventures for meeting the

needs of the Indian Armed Forces as well as subsequent export to mutually friendly third countries by the Sides' approval.[9]

- *Impact of Israel–Palestine conflict*: Israel is a major supplier of sophisticated high-end technology sub-systems for our defence platforms. While the Israeli defence ministry has reassured the Indian side that it will be honouring the timeline-related commitments for ongoing and signed contracts, delays in supply of these sub-systems is expected. Thus, a realistic assessment of the delays and financial impact on supply at sub-systems level is required to be carried out, which may be too premature to judge at this moment.

Measures for Mitigating the Impacts of Wars and Sanctions

Having seen the predicament of the Indian Armed Forces' foreign dependence for its defence needs, it is imperative to identify measures that need to be adopted to mitigate the negative impact of either being directly embroiled in a prolonged conflict, and facing sanctions, or when one or more of our defence suppliers/partners is involved in one. These can be analysed at two levels, that is, measures to be taken at the international level and those which need to be implemented domestically.

Mitigation Measures at the International Level

Diversify Import Sources

Military equipment inventory in India is largely based on whether its origin is a North Atlantic Treaty Organization (NATO) or a non-NATO (Warsaw Pact signatory) state. The lack of interoperability of Soviet-origin equipment with Western-origin equipment in the inventory of the Indian Armed Forces has been a cause of concern for many decades now. Many defence analysts have adversely commented upon the ad hoc manner in which India's defence hardware had been procured in the past, as a mix of NATO as well as non-NATO, mostly Russian origin, equipment. While there were justifiable reasons and compulsions in doing so, this has resulted in myriad logistical and sustenance challenges being faced by the Indian Armed Forces due to foreign inventory dependence, spread over multiple continents, making long-term sustenance of such equipment extremely challenging throughout their respective life cycles.

However, it may also be argued that with a dispersed dependence on a number of import sources, India does not risk a near-total collapse of its defence machinery

during any limited conflict or power arrangements in the world. Furthermore, such a situation would benefit India in a manner that it would not be coerced into any unwanted alliances or activities by way of direct or indirect pressure by its military suppliers. Thus, having well-diversified import sources of military hardware seem to have helped India in the long run.

While the diversified supply source may appear to be a preferred methodology to counter differential drying up of supply chains for defence hardware, there is a need to view the aspect from a more holistic standpoint. The COVID-19 pandemic has also underscored the importance of resilient supply chains, and India can draw lessons from this experience to build a more assured defence logistics system, with secure and short supply chain linkages.

Maintain Trade Balance with Friendly Foreign Countries

The difficulties being faced by India and Russia in various defence deals have been mainly due to Russia's exclusion by the EU, the UK, Canada and the US, as part of economic sanctions, from the Society for Worldwide Interbank Financial Telecommunication (SWIFT) system based at Brussels. This network links more than 11,000 financial institutions all over the world and is the main messaging service being used worldwide for transfer of funds. Though India and Russia tried to work out a rupee–rouble payment arrangement which would not require access to SWIFT, it has not been effective due to an imbalance in the trade exports by the two parties, which is heavily skewed in favour of Russia. Thus, there is a requirement to factor in the issue of trade imbalance when planning imports/exports related to defence/other items with trading partners.

A Need to Capitalise Indian Diaspora's Global Imprint

During the sanctions imposed on India post-1998 nuclear tests, the Indian government was able to offset a major part of the reduction in foreign capital inflows by launching a 'Resurgent India Bonds' scheme, aimed at attracting investments from Non-Resident Indians (NRIs).[10] According to the Ministry of External Affairs, there are around 32.2 million overseas Indians, including 13.6 million NRIs and 18.6 million Persons of Indian Origin (PIOs).[11] It is felt that these NRIs and PIOs must be encouraged to invest into the Indian industry, including the defence sector. Specific policies and measures targeted at facilitating this would not only help the Indian industry to flourish but also provide easy avenues for offshoring production by business houses owned by Indians abroad.

The feasibility of providing extra exemptions/incentives to dual-use sectors, such as telecommunications, information technology and cybersecurity, could be examined. The capability of generating positive global public opinion by the Indian diaspora could be harnessed in attracting global businesses to the Indian shores. Care must, however, be taken to wisely choose the countries in which the Indian diaspora reside, and the likelihood of any conflicts of interest, short term or long term, which India might have with the latter in the foreseeable future.

Measures to be Implemented Domestically

Indigenise Defence Production to the Maximum Extent

The most effective long-term mitigation measure to thwart defence resource shortages would be to ensure maximum possible indigenisation of defence production. However, in today's world, where complex defence products are produced by a lead system integrator by sourcing sub-components from various sub-vendors, who in turn might be spread all across the globe, this might prove to be a challenge. Hence, there is an urgent requirement of ensuring that the country develops its own robust defence industrial base. The ambitious vision of 'Atmanirbhar Bharat' and 'Make in India' initiative by the Government of India are on the right track and showing great promise for the future. The 'whole of nation' would need to continue supporting the cause by ushering in a variety of reforms and improvements. A few recommended measures in this regard are as follows:

- There is need to ensure that certain identified key niche technologies are developed indigenously. These could be defence-specific or dual-use technologies. Towards this end, a concerted effort needs to be put in by the research and development (R&D) establishments, both in public as well as private space. The role of the Defence Research and Development Organisation (DRDO), defence public sector undertakings (DPSUs), private defence industry and academia would be invaluable in this regard. Resolute efforts towards negotiating technology transfer agreements, through intergovernmental agreements with allies and strategic partners, to enhance domestic capabilities and reduce reliance on sensitive imports would also prove to be beneficial in this regard. Public–private partnerships in defence manufacturing would also drive innovation, reduce costs and enhance India's technological capabilities.
- The government has already initiated numerous measures to facilitate

participation of private industry in defence manufacturing by introducing industry-friendly policies and procedures, which relax the norms and clearances required for entry into defence production for not only established industries but also for start-ups and micro, small and medium enterprises. This process is being further encouraged and effectively monitored continuously for implementation. To sustain prolonged conflicts, India needs a robust defence industrial base that can produce, upgrade and maintain equipment at short notice.

- A 'whole-of-nation approach' towards indigenisation of defence production needs to be initiated, with participation of all stakeholders, including the armed forces, the DRDO, the Central Armed Police Forces, the Indian Coast Guard, the DPSUs, academia and the private defence industry. Research and development by the academia needs to be focused and progressive. With 36 per cent of scientists at National Aeronautics and Space Administration (NASA) being of Indian origin,[12] it is axiomatic that there is no dearth of talent pool and intelligence in Indian students. However, an overview of the manner in which scientific research at the graduate and postgraduate level is sometimes being undertaken in India points towards the fact that there is much scope for a focused approach towards research, especially in the field of niche technologies. In a bid to allow academic independence, the research being carried out is often limited to 'scratching the surface' in a multitude of fields. In many instances, only the research proposals received from the academia are selected by the research boards of the institutions. It is pertinent to note that such practice is in sharp contrast to the Chinese model of engaging with the academia, where the National University of Defense Technology has been mandated to identify and allot clear and tangible R&D objectives to be achieved, along with the timelines for the same.[13] It is felt that much better dividends would be yielded if the subjects for research are ab initio listed out by the research boards after an analysis of the existing technology gaps.
- There is also a need to reinvigorate measures that have already been initiated by the Government of India. Maximum publicity to such efforts and opportunities by way of ad campaigns and promotional events would ensure further maximum meaningful participation.
- While maturing technology indigenously and absorbing foreign technology, transfer of technology arrangements should remain the prime focus, in the interim, the mode in which the foreign technology and defence

platforms are imported also requires a relook. To ensure strategic autonomy to upgrade and modify imported systems, including replacements of spares and rotables by indigenously manufactured ones and use of indigenous ammunition, there is an essential requirement to ensure owning the 'know-why' in addition to the 'know-how'. Self-reliance on Indian standards and indigenised equipment with customised 'input–output protocols' of imported systems, along with ready availability of Application Programming Interfaces (APIs) and Interface Control Documents (ICDs), is uncompromisable to ensure long time and uninterrupted sustenance of the foreign-origin weapons and equipment. This would ensure economy and efficiency, as well as steadily reduced dependence on foreign sources without compromising on the smooth functioning and combat readiness of the armed forces.

Strategic Stockpiling

Another focus area is strategic stockpiling to beat supply chain disruptions and supply interruptions in the event of sanctions, etc. In addition to indigenisation of design and manufacture effort at the sub-system/component/assembly level, there is also a requirement to undertake an objective assessment of what all assets, weapons, equipment and ammunition should be held as strategic reserves, should an eventuality arise wherein India itself is embroiled in a conflict situation. This would need to be a deliberate exercise since the stockpiling of such assets would invariably be at a high cost, along with the attendant risk of sunk cost due to wear and tear with passage of time and shelf life, in the event when the stockpiles never get used. Also, a dynamic approach towards varying the degree of stockpiling, in collaboration with the production partners, based on their normal and surge production capability as well as imminence of threat should be adopted.

Harmonising Indigenisation, Innovation and Reverse Engineering Efforts

Reverse engineering and manufacturing, particularly of 'low technology–low risk' items/spares, especially of those spares/components whose origin sources have stopped manufacturing due to the equipment vintage, can go a long way towards providing alternatives to dried-up supply chains. However, adequate care needs to be taken to ensure that there is no violation of intellectual property rights stipulations. There is also a need to ensure that quality assurance of a high order is achieved for such items. This can be accomplished by putting such items through stringent 'form–fit–functionality–firing' trials before accepting them for use in

service. It is also axiomatic that harmonising efforts of the three services, especially towards common areas of interest, such as weapons and ammunitions, radars, fire control systems and unmanned aerial systems/drones, would yield much greater dividends than a siloed approach.

Harnessing the Second-order Effects of Indigenisation

Being self-reliant in production of defence-related as well as dual-use items through indigenisation is sure to bring about many allied benefits to the country. The proposed setting up of the final assembly line for H-125 helicopters by the joint venture between M/s Airbus and M/s Tata Advanced Systems Limited as well as the joint venture for the production of C-295 aircraft for the IAF at Vadodara are examples of such arrangements. Needless to say, any strong sanctions on Indian industry would potentially impact the interests of these stakeholders, and thus prove to be a natural safeguard for the country, depending upon the degree to which the interests of the foreign partner(s) are threatened. As per the Observer Research Foundation, a similar situation was faced by India during the Galwan stand-off, wherein India had certain adverse circumstances to weigh before taking any strong trade-linked/economic/diplomatic measures against China.[14]

These emerging realities of the changing world order mandate an undeniable need for genuine indigenous capability building to strengthen India's position as a credible regional and promising global power which can fend for itself in the rapidly evolving global alliances, conflicts and sanction regimes, fortified against any predictable or even 'Black Swan' events in the world.

Conclusion

India's current geopolitical environment necessitates continuous military preparedness. Extended deployments and potential conflicts could put immense pressure on India's defence resources, requiring efficient resource allocation, inventory management and rapid replenishment capabilities. To mitigate the risks associated with sanctions, India must develop strategies that reduce its dependency on any single foreign supplier. Diversifying the sources of defence imports, fostering partnerships with multiple countries and focusing on indigenous defence production will be essential to ensure that India remains self-reliant and maintains its defence capabilities even during international crises.

India's defence resource management strategies would prove to be critical in navigating the challenges posed by protracted wars and international sanctions.

By enhancing self-reliance in defence production, diversifying partnerships, ensuring resilient supply chains and improving operational readiness, India can mitigate the risks and ensure its national security in an increasingly uncertain global environment. The way forward involves strategic foresight, effective governance and collaborative approaches to defence modernisation and resource management, ensuring that India is prepared for future conflicts while safeguarding its strategic autonomy.

NOTES

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22

Defence Production and R&D in India: Adapting to Externalities

Rajinder Singh Bhatia and Dnyanada Palkar

Introduction

The introduction of the Defence Procurement Policy (DPP) in 2016 was followed by a slew of policy reforms. These reforms led to a rapid change in the Indian defence industry landscape as it opened up defence production to private manufacturers (both global and domestic) and paved the way for indigenisation or *atmanirbharta* (self-reliance) to become a cornerstone for defence production in India. Prior to these reforms, the structure of India's defence industry put the defence public sector undertakings (DPSUs) at the top of the hierarchy of domestic defence manufacturers. Additionally, defence production in India was truly opened up to the private sector only in 2001, after the recommendations of the Kargil Review Committee report.[1] Therefore, up until the early 2000s, Indian private industry remained only suppliers or vendors to the DPSUs, rather than independent defence platform or sub-system manufacturers.

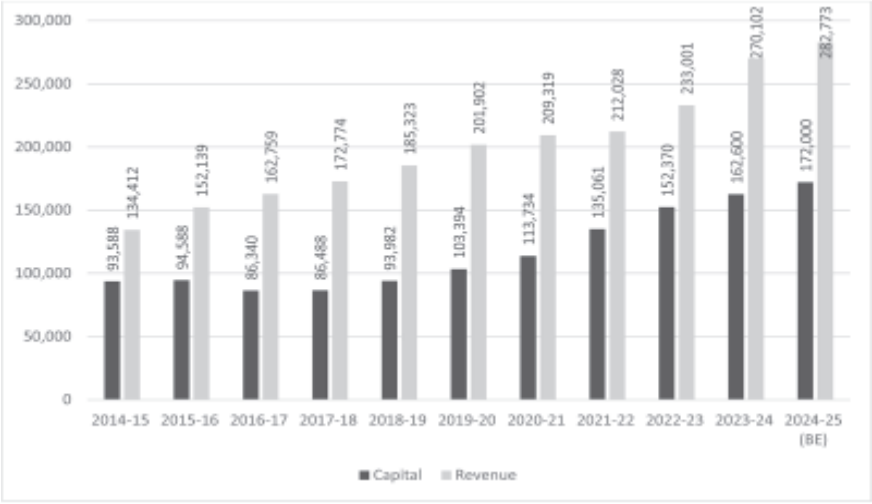
As private industry in India began to build fledgling capabilities in defence manufacturing, the DPSUs—on account of having been the only defence manufacturers in the country for so long—contributed the lion's share to overall defence production in India. This trend is apparent even today, with the DPSUs contributing 79.2 per cent and the private sector contributing the remaining 20.8 per cent to the approximate Rs 1.27 lakh crore value of defence production

in fiscal year (FY) 2023–24.[2] These figures indicate the need for a more 'level playing field' between the public and private sector in defence production. However, it is worth noting that despite the sector being opened up to private participation just over two decades ago, the private defence manufacturers have already captured 20 per cent of the business in the sector.

Given the Government of India (GoI) and Ministry of Defence's (MoD) focus on defence exports from India, it is also important to highlight the contribution of private defence industries in this regard. The value of defence exports from India for FY 2023–24 was a record high of Rs 21,083 crore, of which private defence manufacturers contributed 60 per cent, while DPSUs contributed 40 per cent.[3] This demonstrates that private defence manufacturers can add significant value and spearhead defence exports from India. Another point of import here is that the growth of private defence manufacturers has been driven by increased private investment in innovation and research and development (R&D). A study by the Foundation for Advancing Science and Technology (FAST India) and IIFL Securities found that the Indian defence firms allocate, on average, 1.2 per cent of their revenue to R&D, which is much lower than the global average of 3.4 per cent.[4] However, this is partially on account of the method of recognising R&D in India, where prototypes, trials and testing are not accounted as R&D costs. This reduces the amount of investment factored in as R&D and leads to a lower count of allocations. Despite this, there is still a need for the Indian defence industry to pick up the pace on innovation and R&D. Further, other externalities, like low-intensity conflicts and sanctions, cause Indian defence industry to make optimisation choices between investing in R&D or focusing on supply chain management.

The outlook for the Indian defence sector is positive. An analysis from a Jefferies sectoral report notes that with a market opportunity worth US$ 90–100 billion over the next six years, the Indian defence industry is likely to grow at a compound aggregate growth rate (CAGR) of 13–14 per cent from FY 2024 to FY 2030.[5] Moreover, the MoD's budget has grown (with some variation in year-on-year growth) over the past decade, from Rs 2,29,000 crore in 2014–15 to Rs 6,21,941 crore in 2024–25.[6] Figure 25.1 provides the break-up of the defence budget over the past decade in terms of revenue and capital. The consistently higher allocations to revenue are on account of the salaries and revenue expenses that have to be accounted for. The encouraging trend here is that the capital budget for defence, while less than the revenue budget, has grown equally consistently over the last 10 years.

Figure 25.1: Revenue and Capital Expenditure of Indian Defence Budget (2014–24)



Source: 'Demands for Grants—Ministry of Defence, Government of India, 2014–15 to 2024–25', n. 6.

Given this backdrop, the Indian defence industry is poised to take wing on the currents of domestic and global opportunities. While the future of defence production and R&D in India look promising, there are other factors to take into account that will impact growth and innovation in the sector. Despite significant improvements in the domestic policy and economic environment, the global security and trade environment has grown increasingly rife with conflict and protectionism over the last few years. The next section provides a review of the global security environment and recent developments under modern warfare, such as protracted wars and sanctions regimes. The following section elaborates on how low-intensity conflicts, wars and sanctions qualify as externalities that impact global and Indian defence industry. The concluding section outlines the role that the Indian defence industry can and should play in the evolving landscape of modern warfare.

Global Security and Economic Flux

The world has been in a state of economic flux since the COVID-19 pandemic hit in 2020. Countries made adjustments to their economic and industrial operating procedures in order to adapt to the aftermath of the pandemic. A major security event that followed was Russia's invasion of Ukraine on 24 February 2022. This was the culmination of eight years of low-intensity conflict, since the

annexation of Crimea in 2014.[7] The security priorities of most European countries underwent a major change post Russia's invasion of Ukraine. While smaller conflagrations, like the Nagorno-Karabakh conflict between Armenia and Azerbaijan, had continued for years in Europe, they were rather localised. The full-scale invasion of Ukraine, however, led to Europe coming together to support the country. Thus, on account of the support that the European Union (EU) started providing to Ukraine, as well as due to North Atlantic Treaty Organization's (NATO) commitments, there was an increase in military spending across many European nations.[8]

India's own borders to the north and north-east also witnessed low-intensity conflict with adversaries on those fronts.[9] Geopolitical uncertainties, such as the trade war between the United States (US) and China, in addition to the pandemic, led to economic downturns from 2020 to 2022. Sanctions against not just Russia but also China and Iran were imposed for reasons ranging from the invasion of Ukraine to the trading of arms and the 'spread of the virus'. These sanctions regimes affected several countries, including India. Due to long-standing relations with Russia in terms of arms imports, the sanctions on Russia were an externality that affected India's foreign and security policy choices.

Technology denial has always been and will remain an instrument of foreign policy, which is largely the aim of most sanctions regimes. Sanctions are also intended as a form of economic warfare, which invariably affect third parties despite issues being bilateral in nature. In the case of sanctions, resources are involved in some form—whether financial (currency and payment settlement mechanisms), security (missile defence systems and oil) or agricultural (food or grain). Competition over resources is often cited as a major driver of conflict. Natural resources, like oil, water, metals and minerals, are often found at the heart of conflicts. However, even apart from actual competition over resources, violent conflict caused by other issues can also be financed and prolonged through the exploitation (mostly capture and sale) of lucrative resources.[10]

While the resource–conflict link is touted as a highly stylised one, it does highlight the fact that sanctions are strategic tools used to increase the probability of creating economic shocks.[11] As market readjustment is a long-term phenomenon, economic shocks can cripple an adversary nation's ability to retaliate. Protracted wars or low-intensity conflicts tend to last for long periods, which adds up in terms of administrative and acquisition costs, as well as welfare losses. The reason 'resources' are a critical component for consideration with regard to

defence industry and R&D is that they are a necessary factor of production. Moreover, as protracted conflicts and sanctions can last for long periods of time, it has a direct impact on supply of 'resources'. Within industry, this directly impacts supply chain management and can indirectly impact design and development as well as overall indigenisation.

The impact of externalities, like sanctions or logistical hurdles, on supply chains, and eventually production and prices, is most apparent in the global semiconductor shortage that began in 2020; and this has only just begun to ease this fiscal.[12] Supply chains are invariably linked to inflation as supply is a major determinant of price. Sudden contractions in supply or increases in demand inevitably lead to higher short-run prices. Semiconductors are key components in the production of a wide range of goods, from toys and automobiles to computers and armaments. During the pandemic, demand rose for semiconductors, specifically microchips, as the need for digital devices increased multifold. A simultaneous contraction in chip production became clear as chip manufacturing sites remained either closed or operated with minimal staff. Production was further affected by the trade restrictions that came into force between the US and China in late 2020.[13] After the onset of the chip shortage in 2020, a quick study by the Federal Bank of St. Louis found that prices had increased more significantly for manufacturing industries that needed semiconductors as a direct input. While overall inflation on the heels of the pandemic was high, semiconductor-dependent industries saw prices rise by four percentage points more than other manufacturers.[14] In this case, the pandemic and sanctions, or trade restrictions, contributed to supply chain bottlenecks that inflicted unanticipated and gradually increasing costs on manufacturing industries.

It is these unanticipated costs that are a major concern for industry in general, and for defence industry in particular. Increased input costs necessitate optimisation choices with regard to expenses on factors of production and investments in R&D. Trade in natural resources—which often serve as primary production inputs for most manufacturing industries—is necessarily dynamic. Additionally, international trade in natural resources is often significantly affected by military conflict or the threat thereof. In the context of protracted wars and low-intensity conflicts, especially those with a 'resource angle', prices and quantities of input materials for defence industry can be adversely affected. Given the present security and economic flux across the globe, the rich and complex interactions between economic equilibria and international conflicts need to be further studied from the lens of externalities. It is worth noting that 'the path of prices is affected

by the future probabilities of war, while simultaneously the likelihood of war is shaped by the paths of prices and quantities.'[15] As it is externalities like wars and sanctions that impose increased costs and prices on manufacturing industries, the following section delves into how protracted wars and sanctions qualify as externalities affecting global and Indian defence industry.

Identifying Externalities: Protracted Wars and Sanctions

The simplest definition of an externality is an indirect cost or benefit to an uninvolved third party. Externalities in the context of defence industry are circumstances or conditions that directly or indirectly affect business operations, specifically manufacturing processes and supply chains related to both factors and methods of production. The literature on externalities very often focuses on differentiating between private and social costs (a common approach for welfare economists like Arthur Pigou),[16] and asserting that even competitive markets cannot provide optimality. While the literature is sound in its theoretical base, it often misses out on the real-world effects of external events and costs they impose on private actors.

This chapter centres the identification of externalities in the context of global and Indian defence industry. It also takes this opportunity to situate these externalities in the complexity of real-world interactions, involving large numbers of stakeholders, including governments, industries, industry associations, armed forces, diplomacy, bureaucracy and more. Since the literature focuses more on the actions of private actors (whether households or firms), it fails to take into account costs incumbent upon state interventions, like regulations and taxes or subsidies. This is especially important with regard to defence industry as defence manufacturing is a highly regulated sector even without considering externalities. As a result, understanding how externalities affect industry efficiency can help contribute to policy reform in the sector.

There are only a couple of pieces in the literature that focus on industry efficiency, of which Harold Demsetz noted that external impacts on industry efficiency are rarely discussed in the externalities debate, which leads to flawed policy prescriptions.[17] Demsetz highlighted that externalities that inflicted costs on another party can be of two types, especially in the industry context. First, cases where bargaining is possible between the parties. This is largely seen in firm-level interactions, whether in the form of contracts, business-to business outreach or others. Second, cases where bargaining is not possible between parties. This is the case with international conflicts and sanctions. The parties involved in these

cases are usually two nations, or nations and non-state actors or various non-state actors. None of these actors are going to consider the impact their actions will have on industries or manufacturing. Furthermore, these actors are unlikely to come to the table to bargain with industry as their involvement in conflict highlights a focus on security and strategic priorities. Economic or industry efficiency is unlikely to be high on the list of such priorities. Therefore, there is a need to delve into protracted war and sanctions as externalities that impact defence industry and its production efficiency.

Another common assumption when considering the costs imposed by externalities is zero transaction costs. Real-world interactions entail several pervasive transaction costs. These include, but are not limited to, administrative, negotiation and contract enforcement costs.[18] Transaction costs are often used as justification for government intervention in markets and resource allocation. In the case of defence industry, there is already substantial regulation of the sector owing to security exigencies and necessities. Domestic defence industry also functions in a monopsony environment—with the central government of the nation as the only buyer. It is only at the global level, or factoring in defence exports, that defence industry functions in a competitive market. However, at both global and domestic levels, defence industry is heavily regulated and does not function within a fully competitive market environment due to security and strategic concerns of the sector.

Economic shocks are unexpected, singular occurrences or events, such as a terrorist attack or an oil supply crunch, which affect prices directly, but normalise within the short term. Externalities, on the other hand, have indirect effects on production or consumption and can have long-term effects on prices and production quantities. Taking the example of the Russia–Ukraine war, the primary actors are Russia and Ukraine, and in secondary or supporting capacity are the EU and the US. The war and subsequent sanctions placed on Russia drove oil prices up, which directly impacted certain industry sectors, like transportation, fertilisers, agriculture, plastics and chemicals, and indirectly affected prices in all other sectors, leading to price inflation.[19] Given that Russia and Ukraine accounted for approximately 30 per cent of all wheat exports in the world, post-war there was an immediate shortage of the grain, causing prices to soar. Supply chain disruptions in fuel and food as a result of the war led to global price inflation that is yet to abate. The Food and Agriculture Organization Food Price Index stood at 124.4 points in September 2024, a 3 per cent increase since March 2022.[20] This

is indicative of the long-term and sticky effects that externalities like protracted wars can have on prices, even in industries not immediately or directly impacted.

For the global and Indian defence industry, protracted wars and sanctions and their effects as externalities can be understood with a few simplified scenarios. Focusing only on the defence industry and business operations integral to production, and factoring in effects of protracted wars and sanctions on supply chains and prices (based on the analysis from previous sections), the scenarios are outlined next.

Protracted Wars

- Supply chain disruptions are a direct effect of conflicts. These disruptions are owing to contractions in supply of a commodity or product, or disruptions in transportation and logistics. This is evident from the case of the global semiconductor shortage. This scenario leads to an increase in prices for vital production inputs, like semiconductors, that defence manufacturers must internalise in order to keep their platforms or systems competitive in both domestic and export markets.
- Price inflation is an indirect effect of conflicts. This can be a result of supply chain bottlenecks or can be due to contraction in demand for production inputs in the short run. This is apparent in the case of reduction in wheat production in both Russia and Ukraine, which led to a domino effect on food prices, thereby leading to price inflation in the long term.

Sanctions

- Supply chain disruptions are a direct effect of sanctions. Supply chain bottlenecks are caused as either an entire nation or firms and entities within it are banned from trade or payment settlements. This forces costs on industries for finding alternative sources for production inputs and alternative methods for payments.
- Price inflation is an indirect effect of sanctions. The decision to cut off supplies or prevent supply of critical inputs, like oil and gas, leads to sudden contractions in supply, which drives up prices of fuel and energy. All industries bear the brunt of increased costs as fuel or energy are essential production inputs. Price inflation in fuel persists in the long term, necessitating optimisation choices, like reduction in production quantities.

The given scenarios highlight that supply chain disruptions are a direct effect of both protracted wars and sanctions. Price inflation, which is more of a concern

for defence industry with regard to production inputs, is an indirect or secondary effect. This qualifies both protracted wars and sanctions as externalities—as both are activities that impose costs on unrelated third parties and both indirectly impact prices. It is abundantly clear that no matter the nature of the externality, higher costs and prices need to be factored into industrial processes. Adapting to these externalities requires global and Indian defence industry to take on higher administrative and negotiation costs, as consistent dialogue with governments and regulatory agencies is required for production and operations to run as efficiently as possible. Optimisation choices must be made and are the main method of dealing with internalising costs imposed by externalities.

Innovation and R&D are the pillars on which India's defence industry must base its future growth. However, the costs imposed by externalities force industry to choose between managing input costs or investing in R&D, design and development. This restricts the pace of innovation and subsequent indigenisation. Technology development begins when there is a sentiment for encouraging design and development in the ecosystem. The GoI and the MoD have facilitated capacity building for micro, small and medium enterprises (MSMEs) and start-ups in the defence sector by introducing various schemes, like Innovations for Defence Excellence (iDEX; 2021) and Acing Development of Innovative Technologies with iDEX (ADITI; 2024). Thus, the government has demonstrated not only the sentiment but also the will to promote indigenous technology development.

The introduction of Positive Indigenisation Lists (PILs), which act as an import embargo, is another indicator of the willingness of GoI to nurture Indian defence industry's R&D and technology development capacities. The following section examines the Indian defence industry's role in adapting to externalities, as well as balancing production and innovation while catering to the domestic and global market.

Adapting to Externalities: The Role of Indian Defence Industry

Internalising increased prices is an immediate concern for defence industry. The optimisation choices necessitated by long-term price inflation of vital production inputs creates a conundrum for the Indian defence industry. Certain decisions, like reducing production quantities until higher prices persist, invariably lead to delays in production timelines, bringing on contract enforcement and negotiation costs. Alternatively, both public and private defence manufacturers could make the decision to forgo innovation by diverting funds allocated for R&D towards internalising higher prices. These decisions and optimisation choices are also

affected by the fact that defence manufacturers cannot pass on higher prices to the customer—which in most cases are central governments (whether GoI or foreign governments)—owing to contract stipulations and heavier sectoral regulations.

Private Indian defence manufacturers must walk the tightrope between making production processes more efficient and allocating enough funds from their revenues towards R&D. Despite having barely a decade to begin developing meaningful defence manufacturing capacity, Indian private defence manufacturers have managed to capture both the domestic and exports market more effectively than the DPSUs. Private defence firms in India have been able to achieve this partly through diversifying their vendor base and partly through partnerships with foreign original equipment manufacturers. Issues like intellectual property and lack of innovation continue to affect the overall industrial efficiency of Indian defence manufacturers. Focusing on exporting platforms and systems to foreign markets has stood private Indian defence firms in good stead, as exports help offset other transaction costs incurred in developing defence manufacturing capacity.

Diversifying their vendor base will help Indian defence manufacturers to not only make their supply chain resilient but also create opportunities for bottom-up innovation. There is policy support for MSMEs and start-ups in the defence sector, which make up the bulk of the vendor base for large defence primes in India. Increased funding for R&D through MSMEs and start-ups in the sector has been point of focus for policy advocacy, and has also been visible in action through iDEX and Technology Development Fund. This helps shift some of the burden of R&D from large defence manufacturers and allows focus on technological innovations to meet the challenges of modern warfare, ranging from cybersecurity and electronic warfare to artificial intelligence and machine learning. Since the roll-out of iDEX, over 2,000 proposals have been received from the Indian industry, of which 155 challenges will be contributing to the completion of 171 contracts. Additionally, since 2022, 213 MSMEs and start-ups have been actively participating and 19 cases worth over Rs 2,000 crore have been accorded Acceptance of Necessity (AoN), of which contracts over Rs 784 crore have been completed.[21]

In conclusion, it is clear that protracted wars and sanctions are mainstays of modern warfare. These act as externalities that impose significant costs through supply chain disruptions and price inflation, which adversely affects the efficiency

of global and Indian defence industry. Adapting to these externalities and their attendant costs is vital, especially for the Indian defence industry which is poised to take its place on the global stage. The lack of studies on externalities and their effects on industry efficiency, specifically on innovation and R&D in defence industry, needs to be addressed. The interactions between economic equilibria, international conflict and trade need to be studied in further detail. Modelling complex scenarios by factoring in externalities and their effects on defence industry could help industry discover more efficient choice matrices with regard to innovation and indigenisation, as well as contribute to more accurate policy prescriptions.

NOTES

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23

Collaboration with Foreign Partners for Self-reliance

Amit Cowshish

Self-reliance has been a long-cherished goal of successive governments for more than three decades. In the 1990s, a committee headed by late Dr A.P.J. Abdul Kalam, who later became the President of India, had suggested a road map to increase the expenditure on local procurement from 30 per cent of the total expenditure on defence procurement in 1992–93 to 70 per cent in the ensuing 10 years. This was intended as much to promote local manufacturing as to achieve strategic autonomy through self-reliance in defence production. The target could not be realised within a decade, but by 2017–18, the expenditure on local procurement indeed inched up to 60.08 per cent of the total expenditure on procurement.[1] It went up further to 75 per cent by 2023–24,[2] thanks largely to the policy of sourcing more and more of defence materiel from Indian companies, allowing them the latitude to tie up with foreign original equipment manufacturers (OEMs) or technology providers.

Considering that India has a lot of catching up to do with technologically advanced nations, especially with one of its neighbours to the north, the official policy has been to achieve self-reliance, largely through technology transfer from foreign companies. This has been supplemented by some disjointed efforts at promoting research and development (R&D) in defence. Consequently, practically all major equipment, weapon systems and platforms used by the armed forces are generally of foreign origin, even if some of these are manufactured in India, with some Indian-origin components, like radars, being integrated with those systems.

This policy has undoubtedly given a fillip to the Indian defence industry, but it is arguable that the rising expenditure on procurement from local sources is also an indication of increasing self-reliance in defence production. According to Stockholm International Peace Research Institute (SIPRI), India has been the largest importer of arms during successive four-year blocks starting with 2010–14, except during three four-year blocks (2014–18, 2015–19 and 2016–20), when it was pipped to the top slot by Saudi Arabia.[3] During 2019–23, India accounted for 9.8 per cent of the global arms imports, up from 9.1 per cent in the previous four-year block (2018–22).[4] These statistics are not compatible with the popular narrative that India is becoming increasingly self-reliant, of which rising expenditure on procurement from Indian companies is an irrefutable indicator.

For sure, this dichotomy is due to the difference in approach to measuring the volume of imports. While SIPRI measures the volume of deliveries of major conventional weapons and components to a country using a common trend-indicator value which is intended to reflect its military capability rather than its financial value,[5] the Indian Ministry of Defence (MoD) measures imports in terms of the payments made in foreign currencies to foreign vendors during a particular year. Consequently, it will be legitimate to argue that the inference SIPRI data lends itself to is open to question, but it will be equally questionable to claim that the rising expenditure on domestic procurement is a true indicator of declining dependence on equipment of foreign origin and growing self-reliance in defence production.

The reason why expenditure on local procurement cannot be a true indicator of self-reliance is simple. Most of the contracts are awarded to Indian companies as prime vendors under acquisition categories, like Buy (Indian–Indigenously Designed, Developed and Manufactured), Buy (Indian) and Buy and Make (Indian). Under these categories, the Indian companies are permitted, to varying degrees, to tie up with foreign companies for transfer of technology (ToT), obtaining specialist services or importing raw material or some critical components. All payments to the local companies are made in Indian rupee, which accounts for the rising expenditure on local procurement, without any corresponding remission in dependence on the foreign partners for technology transfer, raw material or other specialist services. This is also true of the equipment manufactured (or to be manufactured) in India under other categories, like Buy (Global–Manufacture in India), Make and Strategic Partnership Model.

Somewhere along the line, maximising the indigenous content (IC) in

equipment manufactured in India with ToT from foreign OEMs has also become an important component of the approach to self-reliance in defence production. According to the Defence Acquisition Procedure 2020 (DAP 2020), the IC requirement in equipment procured under various categories—except Buy (Global), which entails outright purchase of the required equipment from foreign sources—ranges between 50–60 per cent. Although the IC is also measured in monetary terms,[6] this is a better indicator of self-reliance than the expenditure incurred on local procurement. However, even maximising IC in the locally manufactured (or assembled) equipment is not sufficient for achieving self-reliance in the true sense of the term.

This is best explained by a recent example. On 28 October 2024, Prime Minister Narendra Modi and his Spanish counterpart, Pedro Sanchez, inaugurated a plant in Gujarat's Vadodara where Tata Advanced System Limited (TASL) will assemble C-295 transport aircraft for the Indian Air Force (IAF). Most of the airframe components are being manufactured and assembled at TASL's Hyderabad factory, from where these will be transported to Vadodara for integration of some critical components, testing and final delivery to the IAF. It is the first facility to come up in the private sector for manufacturing military aircraft, which, till now, were manufactured only by the state-owned Hindustan Aeronautics Limited.

Media reports suggest that about 95 per cent of the aircraft will be indigenous, which will be probably the highest-ever IC in any platform manufactured in India with ToT. While the IC will include such high-tech components as the electronic warfare suite, developed by the state-owned Bharat Dynamics Limited, some critical components, like the engine and avionics, will be imported. This undermines self-reliance as the aircraft cannot fly if, for whatever reason, the supply of these components gets disrupted.

This is true of many other platforms, like the light combat aircraft (LCAs), Su-30MKI fighter jets and Hawk trainer aircraft, which are powered by imported engines, though their IC is 82 per cent, 68 per cent and 71 per cent, respectively.[7] Likewise, some major equipment and weapon systems used by other services are also import-dependant.

Dependence on import of critical components militates against genuine self-reliance because protracted wars, geopolitical considerations and sanctions can disrupt the supply chain and, consequently, local production. It is widely believed that the delivery of Admiral Grigorovich-class frigates from Russia to India has been delayed not only because the Russian defence industry is preoccupied with

meeting the requirement of its own armed forces which have been engaged in a war with Ukraine, but also on account of Western sanctions and Ukraine's embargo on military exports to Russia. This embargo has affected the supply of engines manufactured by Ukraine's Zorya Mashproekt, which power the frigates. The supply of S-400 air defence system, nuclear-powered submarine and AK-203 assault rifles is also affected because of the Russia–Ukraine conflict, which has persisted for more than three years now.

As countries like Japan and Germany, which had generally stayed away from the arms race, are now feeling the need to increase their defence budgets due to geopolitical considerations, the major defence companies in the United States (US) and Europe are less likely to feel compelled to do business in India at the cost of having to part with closely guarded technologies, which, in any case, they have generally been reluctant to do. This could potentially limit India's ability to negotiate extensive ToT as a part of the acquisition contracts, even if the probability of that happening in the immediate future is not very high, given India's criticality in the emerging multipolar world order. The point, however, is that a truly self-reliant India must be prepared to face that eventuality.

This is not to argue against foreign collaboration by the Indian companies—in fact, such collaboration is crucial for self-reliance—but merely to suggest that the approach to self-reliance needs to be revisited. To recapitulate, as the policy stands today, self-reliance is measured in terms of the expenditure incurred on procurement of defence materiel from the local industry and the extent of IC in the products so procured. This needs to change.

To begin with, self-reliance must be redefined as the ability of the Indian industry to design, develop and productionise critical technologies without which the equipment required by the Indian Armed Forces, not only now but also in foreseeable future, cannot be operationally exploited. In other words, the Indian industry must have the capability to manufacture sophisticated, futuristic equipment without depending on import of the most critical components or technologies required for local production.

If the country possesses this capability, the percentage of IC in the product made in India, though important, would matter little, provided the non-critical components are available from multiple sources, which will minimise the prospects of disruption in the supply chain because of external factors, like wars, sanctions and diplomatic snafus. This calls for shifting the focus of self-reliance from ToT as a part of the acquisition programmes to development of critical technologies

which are unlikely to be shared by foreign companies, or disruption in whose supply could affect domestic production. Thus, defence R&D, and not acquisitions, must be the primary vehicle for achieving self-reliance.

It is not that no efforts have been made. The Defence Research and Development Organisation (DRDO), under the Department of Defence R&D, has been engaged in defence R&D since 1958. It has successfully executed numerous projects in diverse fields, like aeronautics, armaments, combat vehicles, combat engineering, electronics, missiles, life sciences, materials and naval systems. However, the fact that two committees had to be set up within a space of less than two decades—Kelkar Committee in 2005 and Raghavan Committee in 2023—to revamp and restructure the organisation indicates that something somewhere is lacking.

In a December 2023 review report on DRDO's functioning, the Standing Committee on Defence observed:

> scores of projects with DRDO were plagued by time and cost overruns and several projects were short closed due to change in the General Staff Qualitative Requirements (GSQRs) by the user or due to technological obsolescence... unanticipated technical complexities, technological denials and price inflations in capital equipment to be sourced from foreign Original Equipment Manufacturers (OEMs), and related feasibility issues etc.[8]

Not to put too fine a point on it, and without in any way disparaging DRDO's achievement, the committee's observation implies that the intended outcomes are not being achieved as expected.

The main problem with the efforts made in the past, and being made at present, is that these are disjointed. An example of this disjointedness is the launch of the 'Kalam Vision: Dare to Dream' scheme to 'unearth unexplored ideas and concepts in technologies identified by DRDO for enhancing defence capabilities', in addition to the Technology Development Fund scheme, launched just a few years back 'to create an ecosystem for enhancing cutting edge technology capability by inculcating R&D culture in Industry for building indigenous state-of-the-art systems for defence applications'.[9]

Alongside, an analogous Innovations for Defence Excellence (iDEX) scheme is also being run by the Defence Innovation Organisation, under the aegis of the Department of Defence Production, to develop new, innovative and indigenous technologies for the Indian defence and aerospace sectors. Each of the three services, on their part, are also engaged in indigenisation under the aegis of their respective

directorates of indigenisation. These efforts are commendable but do not seem to add up to a whole.

Going by empirical evidence, structural, procedural, budgetary and attitudinal reforms are required to reorient indigenous R&D towards plugging the gaps in local defence industry's capability to develop futuristic, emerging and disruptive technologies, with a view to mitigating the risks of critical dependence on foreign sources of supply.

First, the structural issues. Presently, the DRDO is the government's think tank on defence R&D; it is also a planning body and an executive agency to boot. Its sphere of activities includes the following:

- It advises Raksha Mantri on all scientific aspects of weaponry, weapons platform, military operations, surveillance, support and logistics.
- It apprises, assesses and advises him on the impact of emerging developments in science and technology on national security.
- It functions as the nodal coordinating agency of the MoD on all matters relating to instruments of accord with foreign governments relating to acquisition of technologies where export to India is the subject of national security-related controls of foreign governments.
- It deals with matters relating to relations with R&D organisations of other countries and with intergovernmental agencies, particularly those relating to scientific and technological aspects of national security.
- It oversees arrangements with universities, educational and research-oriented institutions to provide for foreign scholarships and training of Indian scientists and technocrats under its administrative control.[10]

Besides the MoD, DRDO's client base includes the Ministry of External Affairs, the Ministry of Home, the armed forces, R&D centres of other governments and departments, public and private sectors, academic institutions and public sector undertakings.[11] These functions need to be segregated as the expanse of its remit makes the DRDO an unwieldy organisation.

In the US, the responsibility for developing emerging military technologies rests with the Defense Advanced Research Projects Agency (DARPA). According to its official website (https://www.darpa.mil/about-us/about-darpaIt), the agency functions with a small complement of approximately 220 government employees—whereas DRDO has more than 26,000—in six technical offices, including nearly 100 programme managers, who together oversee about 250 R&D projects. Most of the work is outsourced to the private R&D agencies, with the DARPA

coordinating all those efforts. In 2005, the Kelkar Committee had recommended setting up of a Board of Research for Advanced Defence Sciences (BRADS) to function on DARPA's lines, but the government did not accept the recommendation. It is time the recommendation is revisited.

Second, the procedural issues. The DRDO follows a hackneyed procedure that is oriented towards acquisition of prototypes with design and development being incidental to it. The DRDO procurement manual is more about the procedural and financial aspects of contracting than about execution of developmental projects and removing roadblocks which are bound to surface in every such project.

Normally, R&D projects would entail collaboration with foreign companies, at least for co-development projects. Even co-production acquisition projects entail collaboration with foreign companies. However, the procedures and protocols for execution of such projects are inadequately defined and personnel inadequately trained in programme management. The procedures are focused more on safeguarding the government's investment in the projects than on ensuring that the objectives of the programme are realised. The need for caution in handling public funds cannot be overlooked, but all developmental projects entail an element of risk. The existing procedures militate against bold decision making and have promoted a culture of risk aversion, which has now become the bane of developmental projects.

The procedures must strike a balance between canons of financial propriety and risk aversion, and also factor in the concerns of the developers and foreign technology partners, be it regarding protection of intellectual property rights, limitation of liability, sharing of sensitive data, security, capacity of the Indian industry to absorb technology, regulatory framework, efficacy of the grievance redressal mechanism, etc. The expectation from the technology providers must be realistic. No company would part with state-of-the-art technology unless there is a strong commercial case for it. Protocols for undertaking co-development, co-production projects must be developed taking this into account.

Third, the financial issues. It is undeniable that the resources available for developmental projects are simply not enough. The proportion of R&D budget to the total defence budget has come down from 6.6 per cent in 2014–15 to 5.38 per cent in 2023–24.[12] Considering that a sizeable portion of the budget goes into payment of salaries and other revenue expenditure, the actual sums available are not enough to propel a major self-reliance push. In fact, out of Rs 21,330.20

crore allocated to the DRDO in 2022–23, only about Rs 5,000 crore was meant exclusively for R&D; and out of that, approximately Rs 1,300 crore was earmarked for the private sector.[13] As a proportion of the gross domestic product also, the R&D budget has come down from a meagre 0.088 per cent in 2017–18 to 0.078 per cent in 2023–24.

The government funding of R&D needs to be substantially supplemented by private sector investment. Not that the private sector is unwilling to invest, but the level of investment remains low because of the uncertainties surrounding the return on investment. The R&D policy of the government needs to focus on making it attractive for the private sector to ramp up investment in defence R&D. It requires a continuous dialogue between the officialdom and the private sector.

Lastly, the attitudinal issues. Developmental projects cannot be seen merely through the prism of contractual relationship between the buyer and the seller. It works best in a partnership mode, which the bureaucracy, whether civil or military, is not quite used to. This attitude also has to change. In the MoD's context, contractual relationship is characterised by the tendency on the part of the officials to be on continuous watch to detect contractual breaches and to penalise the defaulter. The more successful models elsewhere in the world follow a different approach, which is characterised by the buyer 'owning' the contract and ensuring that any roadblock that comes up during its execution is removed as soon as it crops up, by thinking out of the box, if required. This is the key to success. As the Irish playwright George Bernard Shaw had said: 'Progress is impossible without change, and those who cannot change their minds cannot change anything.'

To sum up, self-reliance in defence production cannot be measured in terms of the expenditure incurred on procurement of defence equipment from Indian companies and the extent of IC in the products so procured. Self-reliance, in the true sense of the term, must be viewed as the capability of the Indian industry to design, develop and productionise critical technologies without which the equipment cannot be operationally exploited. It must also include the ability to locally manufacture all manner of equipment required by the armed forces at present, and in the foreseeable future, without the apprehension of any disruption in production on account of the dependence on import of some critical component.

This does not preclude foreign collaboration, but the concerns of the foreign companies, as much as that of the Indian companies, need to be factored into the MoD's policies and procedures. These are commercial organisations and their

business sensitivities, about ease of doing business, return on investment and an efficacious grievance redressal mechanism, must be honoured. This may require setting up of an overarching organisation to shortlist and plan critical projects, evolving flexible procedures for execution of developmental projects, figuring out how to make it attractive for the private sector to invest in such projects and coordinating all developmental efforts by involving the private sector and employing professionally qualified programme managers.

Speaking at the India Ideas Conclave 2024 event in Bengaluru on 22 November 2024, External Affairs Minister Dr S. Jaishankar said that the next world war will be fought on chips, emphasising the need to invest in building up the semiconductor industry. He reminded the audience that the Semiconductor Complex Limited (SCL) was established at Chandigarh in the 1980s, 'way before China and Taiwan entered the global fab (fabrication facility for semiconductors) race'.[14] The subsequent neglect put paid to the pioneering efforts initiated more than four decades back. India can ill afford a rerun of such neglect if it has to become self-reliant in the true sense of the term.

NOTES

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24

Logistics in the Times of Protracted Conventional Wars Under the Shadow of Sanctions and Export Control Regimes: Japan's Perspective

Sadamasa OUE

Introduction

Japan adopted a new National Security Strategy (NSS), National Defense Strategy (NDS) and Defense Buildup Plan (DBP) on 16 December 2022. This transformed its defence approach from being exclusively defence oriented to an offensive posture, possessing counter-strike capability, for the first time in the history of Self-Defense Forces (SDF).[1] The decision was made to face a threatening security environment as severe and complex as it has ever been since the end of World War II.[2]

China had intensified its attempts to unilaterally change the status quo by force in the maritime and air domains, while strengthening its strategic ties with Russia and attempting to challenge the international order.[3] Simultaneously, North Korea, armed with various types of missiles, including nuclear capable and hypersonic, had increased hostile military provocations against South Korea, the United States (US) and Japan. Against these threats, Japan needed to fundamentally reinforce its defence capabilities, including an over-the-horizon counter-strike capability, integrated air and missile defence and robust cross-domain operations.

The strategies also emphasised that Japan's defence capabilities must be able to respond to new ways of warfare because of advances in science and the growing importance of protecting the domain of space. To implement these strategies and plans, Japan proposed to double its defence budget to 2 per cent of the gross domestic product (GDP) by 2027.[4] In addition, the strategies stressed on strengthening the Japanese defence industry as an inseparable defence capability and exploring a more robust and resilient arms export policy.

Galvanised by the logistic demands of the Russo-Ukraine war, the Ministry of Defense (MoD) decided to invest 18 trillion Japanese yen to enhance sustainment and resilience for the next five-year plan.[5] Substantial defence budget increases were needed due to years of declining defence spending. Japan's domestic defence industry revival depended on three things. First, each defence company needed to rapidly expand its research and development (R&D) capability and production capacity to meet the surging demands of the SDF. Second, Japan needed to prepare for exporting defence products, service and technology to foreign military markets. In this regard, the Japanese government considered reviewing the 'Three Principles on Transfer of Defense Equipment and Technology' and its Implementation Guidelines (Three Principles and IG), not only to exploit the foreign defence market for the domestic industry but also to implement Official Security Assistance (OSA) projects.[6] Third, defence supply chains needed to be reconfigured to mutually complement the US and allied capabilities; minimise dependence on undesirable sources, such as China; and be capable to guarantee security against cyberattacks and foreign influence.

Adaptation to the new security environment requires unity of effort among all relevant parties, public and private as well as domestic and international. The following section analyses the Japanese defence industry today and tomorrow, arguing how to overcome difficult issues, like introducing start-ups and commercial sectors which possess advanced technologies and products applicable for military use. The next section discusses Japan's recent move to enhance logistic cooperation with the US, following coordinated response to Russia's aggression, through financial sanctions, export controls and other steps. This bilateral logistic cooperation may be expanded to an international initiative to include Taiwan. Finally, three policy proposals are presented to enhance the Japanese defence industry envisioned in the strategies and create resilient logistic supply chains to support possible war in the future.

Japanese Defence Industry in Transition

At the time when I retired as a Commander of Materiel Command in 2017, the Japan Air Self-Defense Force logistic function was in a serious condition. A shortage of spare parts due to budget constraints pegged at 1 per cent of the GDP had caused a decline in the operational readiness rate of equipment, including F-15 fighters. Many defence companies went out of business. Although the MoD made every effort to sustain a strong defence industry, including a decision of 'Strategy on Defense Production and Technological Bases' in 2014,[7] it could not produce what was needed due to Japan's economic stagnation.

Since the Japanese defence industry was prohibited to export weapons and related technologies, the reduction in SDF contracts directly impacted its defence business. Making matters worse, increase in foreign military sales contracts, such as those for the F-35, reduced domestic defence contracts. However, Japan's defence industry was expected to improve once the policy changes introduced by the three security documents in 2022 began being implemented.

The Kishida cabinet introduced three security documents in 2022 to fundamentally reinforce Japan's defence capability, and also increased the defence budget by up to 2 per cent of the GDP by fiscal year (FY) 2027 to implement the 43 trillion yen (US$ 282 billion) DBP.[8] The NSS stated that Japan will 'reinforce defense production and the technology base as defense capabilities themselves' and 'promote transfer of defense equipment and technology',[9] Thus, according to the MoD budget for FY 2024, a sufficient budget was secured to steadily execute the contracts which drastically increased in FY 2023, and 42 per cent of the expenses stipulated in the DBP were allocated for contracts.[10] Similarly, the MoD budget request for FY 2025, the third year of DBP, has consistently increased, including 101 billion yen for reinforcing the defence production base, in addition to the budget for procurement, R&D, as well as increasing sustainability and resilience.[11]

The defence industry seems to be on the right glide path now. A major effort is underway to increase production capacity; reallocate engineers and labour to defence sectors; and develop new equipment and technologies to meet the SDF requirements. Nevertheless, how the industry will and should transform is neither clearly mentioned nor managed. There is also the question of whether the right stuff is being bought as this process is dynamic. Rapid changes in technology, changes in how we fight and lessons learned from the war in Ukraine must be closely monitored and evaluated. The challenges that the Japanese defence industry

faces include not only budget constraints but also the existing cumbersome, bureaucratic R&D and acquisition process; reluctance to collaborate with newcomers, such as start-ups; and existing obsolete infrastructure.

Moreover, there is a common dilemma for the defence industry in every country. While they all need a wide range of defence equipment that uses the latest technology to respond to the security challenges and threats they face, producing and procuring all assets from domestic industry is financially, technologically and economically challenging. On the other hand, relying entirely on imports would leave procurement of defence equipment—a fundamental element of defence capability—to the mercy of other countries, whereby unforeseen circumstances and risks can undermine their strategic autonomy. The difficulty of defence industrial policy lies in constantly dealing with the trade-offs between security requirements and economic sustainability and between autonomy and international cooperation. Without clear strategies to address this dilemma, the Japanese defence industry may face the pitfall of investment without prioritisation.[12] The Japanese government should decide new national defence industry strategies as soon as possible, together with the revision of the Three Principles.

The door to export defence equipment has not yet opened enough for the private sector to actively promote arms sales to overseas market. The NSS mentions that it should consider 'revisions in order to promote smooth transfer of defense equipment and technology of high security significance and international joint development in a broad array of fields.'[13] Accordingly, the cabinet has implemented the mechanism to allow direct transfer of the finished aircraft of the Global Combat Air Programme (GCAP), the joint international development of the next-generation fighter project, from Japan to third countries in March 2024.[14]

Nevertheless, the review seems to have stalled. Unlike South Korea's national promotion for arms export, Japan will allow the transfer of defence equipment and technologies as 'a key policy instrument to ensure peace and stability, to deter unilateral changes to the status quo by force, to create a desirable security environment for Japan, and to provide assistance to appropriate countries.'[15] Although the OSA system has been established and carried out, how to mobilise industrial participation remains a big hurdle.

Japanese defence companies do not have the experience, expertise and appetite for arms export. Unless the government takes a strong initiative to ensure reasonable profit, mitigate any risks to individual companies and provide full support to

expedite cumbersome procedures, they will not pursue the arms export business; and there is always some pushback from activists suggesting people are becoming 'Death Merchants'. Moreover, all exports must observe the security export control governed by the Foreign Exchange and Foreign Trade Act (FEFTA), consisting of an export licence system, list control items and catch-all control.[16] Even after a company obtains arms transfer permission under the future revised Three Principles and IG, it must adhere to FEFTA rules and regulations.

Meanwhile, Japan has banned the export of unlisted dual-use items which could be considered for the development of military capacity to Russia and Belarus since the outbreak of the Russia–Ukraine war.[17] Despite these measures, according to *Nikkei Asia*, a Russian arms maker is importing components for precision instruments made in Japan and Taiwan essential to tank production via a company in China which was set up after February 2022.[18] Drones used by Russia's military to attack Ukraine also contain components made by Japanese companies. Many of the components are home electronics parts exported from Japan. The components are easily available and are believed to have been shipped to another country first (Iran), then diverted for military use as lethal weapons.[19] As professor Suzuki Kazuto, an expert on the issue mentioned, 'the problem is that we now live in an age where weapons can be easily made from things like home appliances.'[20] In such an age, Japan and like-minded countries need to innovate a more effective security control regime to prevent countries of concern and terrorist organisations from acquiring not only dual-use but purely commercial products which could be applied for military use.

In short, Japan needs to transform its domestic defence industry into a more capable, sustainable, autonomous and global security infrastructure. The Three Principles and IG, together with security export control, should be adapted to today's complex security environment.

Multilateral Collaboration Required

In parallel with the above-mentioned domestic efforts, the NSS emphasises the importance of the alliance with the US, including advances in equipment and technological cooperation that capitalises on advanced technologies. Prime Minister Kishida and President Biden issued a US–Japan Leaders' Statement on 4 April 2024, which stated:

The United States welcomes Japan's revision of the Three Principles on the Transfer of Defense Equipment and Technology and its Implementation

Guidelines, which bolsters cooperation through joint development and production to enhance our deterrence capabilities in the region. To leverage our respective industrial bases to meet the demand for critical capabilities and maintain readiness over the long term, Japan will convene a Forum on Defense Industrial Cooperation, Acquisition and Sustainment (DICAS) co-led by the U.S. Department of Defense and Japan's Ministry of Defense to identify priority areas for partnering U.S. and Japanese industry.[21]

In addition, a separate fact sheet pointed to: 'Exploring advanced capabilities cooperation under AUKUS Pillar II.'[22]

Japan and the US also declared a unity of response to Russia's aggression, immediately after the invasion, through financial sanctions, export controls and other steps. They said on 23 January 2024 that they would continue to work with each other in maintaining the sanctions against Russia and supporting Ukraine in line with an agreement the Group of Seven industrialised nations reached last year.[23] In fact, the Russo-Ukraine war, which now has lasted for more than three years, suggests we need to be ready for prolonged conflict.[24] There is a need to plan for unexpected things, like the high consumption rate of munitions and competition over rapidly evolving drone technology. The critical importance of defence production capacity is evident and the latest technological capability must be leveraged to sustain combat operation.

The US has realised the urgent need to shore up the defence industrial base as it continues logistic support to Ukraine while deterring other adversaries. Against this backdrop, the Department of Defense released the first National Defense Industrial Strategy (NDIS) in January 2024 for ensuring that the US defence industrial base meets the demands of a challenging national security landscape well into the future.[25] The NDIS focuses on four key areas critical to building a modernised defence industrial ecosystem over the next three to five years. Those areas include: resilient supply chains; workforce readiness; flexible acquisition; and economic deterrence.

Actions to engage allies and partners to expand global defence production and increase supply chain resilience are proposed as 'Production Diplomacy: Multilateral Collaboration Lessons from the Ukraine Response'. The strategy emphasises: 'Building off the global experience of the Ukraine conflict, there may be opportunities to similarly convene the leadership of allied and partner nations within the Indo-Pacific, to deepen multilateral collaboration on regional industrial base and manufacturing production challenges.'[26]

Echoing the US industrial strategy and based on the three security documents, the Japanese government has moved forward to reinforce Japan–US alliance, as aforementioned. Japan has also agreed with Australia to continue to consult with AUKUS partners to pursue opportunities for cooperation on AUKUS on 5 September 2024 for the 11th Australia–Japan Foreign and Defense Ministerial Consultations.[27] As such, government-to-government (G2G) cooperation to strengthen a mutually beneficial supply chain is in progress. On the other hand, business-to-business (B2B) cooperation, despite its critical importance for materialising G2G cooperation, seems to be progressing slowly, if at all it has started.

Earlier, the Japanese defence industry used to enjoy licenced production of American defence equipment, such as the F-15, with the exception of certain classified programmes. As the strategic competition against China intensified, the US tightened access to military technologies, such as the F-35, even to its allies, including Japan. Therefore, except for the national joint development projects, such as SM-3 Block 4, B2B cooperation in defence production and R&D has lost momentum recently.

Inherently, B2B relations are both cooperative and competitive. Unless both sides find mutual benefits to reach comparative advantage, relationships in similar defence domains are likely to compete in technology, workshare, profit and subject market. For instance, even if G2G agree to conduct joint development or production of jet engines, every company which would like to participate has its own strategy and goal based on its capacity and technologies. They must negotiate on complicated issues, including technology transfer and releasability, ownership of produced intellectual property, roles and responsibilities, contingency plans and more. In this sense, India's deal with the US for transferring state-of-the-art fighter jet engine technology can be a good model for successful B2B collaboration.[28]

The first action that the US NDIS proposes is to incentivise industry to improve resiliency by investing in extra capacity. As the Japanese government has decided to invest the lion's share in its domestic defence industry, the investment needs to be guided to achieve not only enhancement of domestic production capacity but also collaboration with the US and Australia on a regional defence industry base. The NDIS also proposes to leverage data analytics to improve sub-tier visibility to identify and minimise strategic supply chain risks and to manage disruptions proactively. Simultaneous precision explosions of mobile devices in

Lebanon graphically demonstrated risks concealed in the supply chain.[29] The Japanese supply chain, which may be vulnerable against physical as well as cyber intrusions, must become more secure so that both supply chains complement and supplement each other. The MoD legislated the Act on Enhancing Defense Production Base in May 2023 to increase visibility of supply chain from a prime company to vendors, to provide financial support for mitigating supply chain risks as well as promoting the transfer of products and to ensure protection of confidential information. As legal frameworks and budget investment are agreed upon, implementation efforts by all parties must be made.

Integrated deterrence advocated by the US becomes a shared concept to build up defence posture in the Free and Open Indo-Pacific (FOIP). Logistics and industrial base are inseparable parts of an integrated deterrence posture, which essentially require multilateral cooperation. Japan and the US need to make the most use of DICAS as a platform to expedite bilateral collaboration on integrating supply chains, reinforcing production bases and promoting private sector cooperation. Moreover, existing bilateral initiatives, including Japan–Australia and the US–India, need to be connected to form latticed industrial networks, multiplying individual efforts on supply chains and production capacity.

In summary, Japan, the US and partner countries are synchronised in reinforcing their domestic defence industry, mitigating supply chain risks and promoting bilateral logistic cooperation. While the Ukraine war demands democratic countries to integrate these efforts to support Ukraine as well as prepare themselves for potential future crises, authoritarian countries also collude to support Russia. We must take the lead in the competition of defence industrial cooperation.

Policy Proposals that Require Immediate Action

The late Prime Minister Shinzo Abe declared that the 'Taiwan contingency is Japan's contingency as well as Japan–U.S. alliance contingency.'[30] China may use military force to unify Taiwan. The People's Liberation Army's increasingly assertive military activities must be closely watched. Japan, the US and like-minded countries must quickly integrate defence postures to deter President Xi Jinping from crossing the Rubicon. Based on the given analysis, I will propose three policy recommendations, which are explained next.

Swift Revision of the Three Principles and IG and Collaboration with the US and its Partners to Establish a More Effective Security Export Control Regime

Japan's industry has huge potential both in production and technology to contribute to an integrated logistic system that is flexible and connected to multilateral supply chains. Multilateral supply chains with boosted production capacity and comparative technological advantage will certainly enhance Japan's national security against the axis of authoritarian states. Furthermore, Japan and other Western countries need to establish an innovative export control regime that can minimise the risk for potential adversaries and terrorist groups to obtain military applicable products and technologies from Japan or via a third country.

For Japan to move forward towards this goal, it must fully open the door for defence equipment export. The NSS mentions that the Three Principles and IG are to be reviewed, but the Three Principles must be maintained. The Japanese government must abolish this half-hearted, contradictory approach and show its determination to utilise the transfer of defence equipment and technology overseas as a key policy instrument, as articulated in the same paragraph of the NSS. Otherwise, the domestic defence industry will not take it seriously. The DICAS, OSA and other initiatives, including GCAP and frigate export to Australia, should be used to reinvigorate national discussions on this important issue.

Democratic countries and allies need to do a better job of sharing intelligence regarding supply chains of concerned countries—before conflict starts. Specifically, security export control of sensitive goods and technologies essential to military application, such as high-quality semiconductors, needs better and more secure tracking. The case of Russia's acquisition of components for precision instruments made in Japan and Taiwan essential to tank production via the company in China is a good example. Disclosing adversary supply chains will be an effective measure for a domestic company that might be inadvertently involved with unfavourable transactions.

Defence Industrial Cooperation Needs to be Expanded Under the Quadrilateral Security Dialogue (Quad) Framework

Bilateral industrial cooperation has burgeoned between allies and partners. Japan has agreed to explore opportunities to engage within the AUKUS Pillar II initiative. Japan may take other initiatives to establish a more robust supply chain collaboration framework among the Quad members. For instance, Japan and its

partners could pursue a joint development of advanced unmanned assets production in Australia, with technologies and resources provided by Japan and the US and engineers and labour from India. It might help the US Replicator project in the long run.[31] The Association of Southeast Asian Nations (ASEAN) countries is also a good candidate to augment Japan–US defence supply chain collaboration.

Moreover, Taiwan should be considered as a potential partner. Taiwan's robust semiconductor production capacity and advanced technology are an indispensable asset for Japan, the US and allies. Introducing Taiwan's defence supply chain into Japan's system will produce positive collateral effects, including showing the country's determination to support Taiwan. Japan can also learn from Taiwan how to maintain secure supply chains from China's manipulations, and increased exchanges of personnel and information will enhance mutual understanding. Although Japan and the US refrain from having official relations with Taiwan, private companies in the defence industry are not subject to the same level of constraint.

Japanese Defence Industry should be More Active in Introducing Advanced Defence Technologies from the US and Other Partners, including North Atlantic Treaty Organization (NATO) Members and Israel

The only customer of the Japanese defence industry has been SDF, and the partner has been the American defence industry. As the US continues to be the most important partner to deepen logistic collaboration, including defence industries, DICAS needs to extend its scope to B2B initiatives to promote private sector collaboration.

Furthermore, as security cooperation with other countries, including NATO members expands, logistic cooperation with them should be pursued as a next step. When the Three Principles is revised to fully open the door for export, the Japanese defence industry must consider global customers so that it would inevitably establish relationships with foreign partners possessing various advanced technologies. The GCAP is the first international joint development initiative with the United Kingdom and Italy without the US. More international projects should follow this initiative.

Ukraine and the NATO are learning Russian strategy, tactics, weapons and technologies. Israel is also learning those used by terrorist groups and Iran, which is deemed to be supported by Russia, China and North Korea. Japan must take

advantage of the lessons learned in studying these conflicts to better prepare for future war.

In addition, the Japanese government should encourage its domestic industry to engage with the foreign defence industries in Ukraine, the NATO and Israel to take advantage of the most recent combat-proven equipment and technologies.

Conclusion

Japan must implement the NSS, NDS and DBP to reinforce its defence industry. However, more needs to be done to enhance and build a more robust and secure multilateral logistic posture and supply chain. First, the Three Principles must be revised to encourage the Japanese defence industry to engage with global markets and partners. Second, Japan should take the initiative to expand logistic collaboration among the Quad and beyond to include Taiwan. Finally, Japan needs to introduce advanced equipment and technologies not only from the US but also from the partners who are fighting wars.

We are all in this together. On 24 September 2024, President Biden told leaders at the United Nations that the world is at a historical inflection point: 'our task, our test, is to make sure that the forces holding us together are stronger than those that are pulling us apart.'[32] Logistic collaboration and coherent export security are important, yet, at present, remain too immature to make the forces holding us together stronger.

The US, Japan and its allies share a global vision that is very different than authoritarian regimes in the region. Japan can and should assist the US in maintaining strong alliances, expanding partnerships and improving interoperability with countries that seek a more secure and safer world.

NOTES

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12 The author's study on this issue is published in 'Comparative Study of Defense Industries—Autonomy, Priority, and Sustainability', Institute of Geoeconomics, October 30, 2023, at https://instituteofgeoeconomics.org/en/research/2023120753014/.

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Index

9/11 Attack, 24, 195

Aatre, V.K., 270
Abe, Shinzo, 318
Acceptance of Necessity (AoN), 271, 276, 298
Acing Development of Innovative Technologies with iDEX (ADITI), 14, 246, 267
Adani Defence and Aerospace, 210-11
Adani-Elbit Advanced Systems India Ltd, 210
Adaptability, 63, 97
Adaptation, 131-32
Adapting to Externalities, 297
ADITI, 271, 297
Advanced Light Helicopter (ALH), 228
Advanced Medium Combat Aircraft (AMCA), 13, 221-25, 227, 235, 237
Aero Ballistic Hypersonic Missiles, 167
Aero India 2023/25, 221-22, 228-33, 238
Aeronautical Development Agency (ADA), 224
Aeronautical Development Establishment (ADE), 232
Aerospace, 265
Afghan Taliban, 34, 41-43, 45, 47
Afghanistan, 1, 12, 23, 33-34, 39, 41, 44-46, 65, 180, 182, 184-85, 194, 196
Africa, 5, 33, 37, 47, 200
Agility, 90, 96-97
Agni-V, 97
Agniveer Scheme, 83
Air and Aerospace, 2
Air Force, 62, 68, 76-77, 102
Air Force Satellite, 65
Air Force Station Yelahanka, 221, 233
Air Threat Landscape, 173
Air Warfare, 266
Airships, 162
AK-203 assault rifles, 304
Akash Missile, 212
All Domain Mosaic Warfare, 154
Allocation of Business (AOB), 68-69
Allocation of Business Rules, 69
All-of-government Approach, 79
al-Qaida (AQ), 21, 24, 33-34, 36, 38, 42-43
Al-Qaida Centre (AQC), 39
al-Qaida in the Arabian Peninsula (AQAP), 38-39
al-Qaida in the Indian Subcontinent (AQIS), 40
American Civil War, 162
American Supplied Long-range Missiles (ATACMS), 55
Analysing Operation Safed Sagar, 77
Andamans and Nicobar Command (ANC), 73
Anglo-Saxon, 186
Ansarul Jihad (AuJ), 43
Anti-Ballistic Missile (ABM) treaty, 163
anti-Chinese, 183
anti-piracy, 198
Antwerp Federal Judicial Police, 40
Anusandhan National Research Foundation Act, 2023, 243
Application Programming Interfaces (APIs), 286
Approval in Principal (AIP), 273
Archer/SRUAV programme, 235
Archer-New Generation (Archer-NG), 231
Archer-NG MALE UAVs, 232, 235, 237
Armed Forces, 65, 67-68
Armenia, 23, 292
Armenia-Azerbaijan War, 2, 118-19
Army, 62, 68, 76-77, 102
Army Satellite, 65

Artificial Intelligence (AI), 3, 7, 10, 28, 29, 64, 97-98, 102, 118, 120, 141-44, 147-49, 170, 172, 242, 245, 266
in Defence, 144
Revolution, 141
Artsakh, 157
ASEAN+, 184
Ashoka the Great, 91
Asia, 12, 23, 179-82, 184, 186-87, 189, 200
Association of Southeast Asian Nations' (ASEAN), 183, 320
Asymmetric Threats, 62, 94
ATALANTA, 198
Atmanirbhar Bharat, 125, 212, 241, 284
Atmanirbharta, 9, 289
Attack UAVs, 169
AUKUS, 180-81, 317
Pillar II, 316, 319
Australia, 4, 39, 180
Australia-Japan Foreign and Defense Ministerial Consultations, 317
Authority Holding Sealed Particulars (AHSP), 273
Automatic Take-off and Landing (ATOL), 231
Autonomous Systems, 89, 119
Autonomous Weapon Systems (AWS), 142-43, 146
Aviation Industry Corporation of China (AVIC), 245, 257
Avro, 236
Azerbaijan, 23, 292
Aziz, Sartaj, 76
Aziz, Lt Gen Mohammad, 76

Badakhshan, 45
Bakura Doro, 35
Balanced Approach, 101
Balancing Act, 94-95
Balochistan, 41
Bamiyan, 45
Bangladesh, 38, 65
Battle for Hostomel Airport, 129, 131
Battle of Shalateng, 74
Bay of Bengal Initiative for Multi-Sector Technical and Economic Cooperation (BIMSTEC), 183
Beihang University, 257
Beijing, 181-82, 188, 197
Beijing Institute for Aeronautical Materials (BIAM), 257
Beijing Institute of Technology, 257
Belgium, 204
Belt and Road Initiative (BRI), 188, 197
Bengaluru, 221, 309
Ben-Gurion University, 258
Best-value Approach, 124
Bharat Dynamics Limited, 303
Bharat Electronics Limited (BEL), 246
Bharat Forge, 247
Bhatia, Rajinder Singh, 15
Bhattacharyya, Ashis, 13
Bhutan, 65
Biden, President, 321
Biological Weapons Convention (BWC), 53
Birvadker, Oshrit, 12
Black Sea, 155
Blarel, Olivier, 198
Blinken, Antony, 207
Block Development Policy, 238
Board of Research for Advanced Defence Sciences (BRADS), 307
Boeing, 242
Boko Haram, 34-35
Bordeaux, 39
Border Management, 95
Bosnian, 40
BrahMos Missile, 97, 212
BRICS (Brazil, Russia, India, China and South Africa), 187
Britain, 163
Brunei, 148
Brussels, 40, 182, 195, 198
Budgetary Allocation, 103
Burkina Faso, 36
Bush, George H.W., 22
Business-to-business (B2B) Cooperation, 317
Buxar, 92
Buy (Global), 303
Buy (Global-Manufacture in India), 302
Buy (Indian), 272, 302
Buy (Indian-Indigenously Designed, Developed and Manufactured), 302
Buy and Make (Indian), 269, 272, 302

C-295, 230, 236, 238
Cabinet Committee on Security Meeting, 76
Cabo Delgado, 37

Camouflage, Concealment and Deception (CCD), 122
Canada, 185, 204
Caribbean, 200
Caucasus, 40
CEAN, 173
Central Africa, 34
Central Armed Police Forces, 231
Central Asia, 33, 44, 46, 180, 184
Centrally Sponsored Schemes (CSSs), 250
Centre for Economic Policy Research (CEPR), 107
Centres of Excellence (CoEs), 254
Certain Conventional Weapons (CCW), 143
Chadha, Vivek, 8
Chairman of the Chiefs of Staff Committee (COSC), 68
Chandigarh, 309
Chandragupta Maurya, 91
Chechen, 40
Chemical Weapons Convention, 53
Chief of Air Staff (CAS), 221
Chief of Defence Staff (CDS), 7, 63-64, 68-69
Chief System Administrator Integrated Logistics Management System (CSAILMS), 66-67
Chiefs of Staff Committee (COSC), 75-76
China, 1-2, 6-7, 14, 21-24, 27, 54, 56-57, 74, 99-100, 107, 111, 164, 168, 181-83, 185, 188, 193-97, 199, 210, 222, 227, 236, 244-45, 255-57, 287, 292-93, 311-12, 315, 320
China Academy of Launch Vehicle Technology (CALT), 257
China North Industries Corporation (NORINCO), 245
China's Gray Zone Warfare, 21
China's J-20, 166
China-India Conflict, 182
Chinese Belt and Road Initiative, 188
Chinese Western Theatre Command, 73
Choudhary, Ladhu R., 72
CIT, 129, 131-33
Civil-Military Fusion (CMF), 14, 124, 275
Civil-Military Relations, 79
Civil-Military Synergy, 90
Clausewitz, Carl von, *On War*, 21, 28, 160
Clemenceau, Georges, 149
Clinton, President, 76
CM10 Bomark, 163
Coast Guard, 62
Cold War, 1, 7, 22-24, 52, 54, 162, 182, 186, 195, 205, 279
Collective Security Treaty Organization (CSTO), 183
Combat Aerial Teaming System (CATS), 13, 221, 231-32, 235, 237
Combined Joint All-Domain Command and Control (CJADC2), 157
Command and Control (C2) System, 26
Command Intuition Theory and Russian Failures, 131
Command, Control, Communication, Computers, and Intelligence (C4I), 118
Commonwealth of Independent States (CIS), 183
Complementary Strengths, 63
Complex Terrain, 96
Compound Aggregate Growth Rate (CAGR), 290
Conference on Interaction and Confidence-Building Measures in Asia (CICA), 184
Conference on Security and Cooperation in Europe, 185
Contract for Acquisition of Research Services (CARS), 253
Conventional Challenges, 94
Conventional vs. Asymmetric Threats, 94
Corporatised Ordnance Factories (OFs), 267
Cost Effectiveness at the Margin (CEAM), 173
Cost-Efficiency, 97
Côte d'Ivoire, 36
Countering America's Adversaries Through Sanctions Act (CAATSA), 279
Counterterrorism, 196
Counter-UAV Systems, 221
Courage, 128
COVID-19, 197, 283, 291
Cowshish, Amit, 16
Craft (*technè*), 127
Crimea Peninsula, 24, 88, 131-32
Critical Maritime Routes in the Indian Ocean (CRIMARIO), 198
Cruise Missile (CM), 164, 168
Cuban Missile Crisis, 53
Cultural Understanding, 96
Cyber, 98
Cyberattacks, 88

Cyberspace, 2, 26, 61-62, 71, 90, 153
Warfare, 266
Cybrid, 154

Daedalus, 161
Davis, Charles, 73
Dayal, Abhay, 15
Defence Acquisition Procedure (DAP), 123, 238, 266, 274, 303
Defence AI Council, 142
Defence AI Project Agency, 142
Defence Capital Budget Trend, 267
Defence Cyber Agency, 103
Defence Exhibition Organisation, 233
Defence Industrial Corridors (DIC), 267
Defence Industry, 267, 321
Defence Innovation Organisation, 305
Defence Lines of Credits (DLoC's), 269
Defence Procurement Procedures (DPPs), 14, 248, 266, 268, 270
Defence Production, 268
Defence Production and Export Promotion Policy (DPEPP), 269
Defence Public Sector Undertakings (DPSUs), 241, 246, 251, 268-70, 272, 284-85, 289-90, 298
Defence Research, 259
Defence Research and Development Organisation (DRDO), 13, 67, 111, 231-32, 241, 243, 246, 250-55, 258-59, 261-62, 271-72, 284-85, 305-08
Defence Technology and Trade Initiative (DTTI), 280
Defence Testing Infrastructure Scheme, 273
Defense Advanced Research Projects Agency (DARPA), 154, 245, 306-07
Defense Buildup Plan (DBP), 311, 321
Defense Industrial Cooperation, Acquisition and Sustainment (DICAS), 16, 316, 318-19
Delhi Defence Dialogue (DDD), 5-6, 17
Delhi Sultanate, 91
Democratic People's Republic of Korea, 7
Democratic Republic of Congo, 37
Demsetz, Harold, 294
Denial of Use, 265
Department for Promotion of Industry and Internal Trade (DPIIT), 272
Department of Atomic Energy, 243, 261
Department of Defense (DoD), 255-56
Production, 233
Department of Military Affairs (DMA), 7, 68, 69
Department of Science and Technology, 243
Department of Space, 243
Deptula, Lt. Gen. David, 154
Dermer, Ron, 207
Deterrence and Power Projection, 98
Development Agency (DA), 272
Development-cum-Production Partner (DCPP), 247
Dhirendra Singh Committee, 270
Directorate General of Quality Assurance (DGQA), 269
Distant Early Warning (DEW), 163
Distributed Maritime operation, 121
Diversification and Strategic Partnerships, 103
Djibouti, 197
Dnieper River, 56
Doklam Standoff, 25
Donbas, 133

Ease of Logistics (ELOG), 66
East Africa, 34
East Asia, 1, 5, 265
East China Sea, 23
East India Company, 92
Eastern Europe, 265
Eastern Ladakh Standoff, 25
Eastern Ukraine, 88
Eid ul-Azha, 37
Eid ul-Fitr, 37
Eisenhower, Dwight D., 102
Elbit Systems Ltd, 258
Electronic Army, 39
Electronic Warfare (EW), 98, 121, 171-72
Encourage Joint Research Projects, 248
Enhance Intellectual Property Generation, 249
Enhanced Accuracy, 96
Enhanced Battle Space Transparency, 118
Enhanced Performance Parameters (EPP), 266
Establish Defence Innovation Hubs, 248
E-Systems, 67
Ethical Principles for AI, Defence, 144
Ethiopia, 148
EU-India Security and Defence Cooperation, 195, 199, 201
Eurasia, 184, 189

Eurasian Economic Union (EAEU), 183
Eurocopter AS550 C3 Fennec, 228
Europe, 2, 5, 33, 46, 184, 195-96, 200, 304
European Economic Community, 193
European Union (EU), 12, 182, 184, 193-98, 200, 278, 292, 295
  Global Strategy and the Strategic Compass, 196
  Indo-Pacific Strategy, 199-200
  Strategy for Cooperation in the Indo-Pacific, 194, 200
European Union Naval Force (EUNAVFOR), 198
EXIM Bank, 280
Experience (*empeiria*), 127-28, 131
Expression of Interest (EoI), 270

Fear of Failure, 273
Fedayeen (*inghimasi*, fighters-till-death), 43
Federal Bank, St. Louis, 293
First Gulf War, 27
First Person View (FPV), 171
First War of Independence, 92
First World War, 162
Flying Bombs, 164-65
Focus on Research and Development, 101
Food and Agriculture Organization Food Price Index, 295
Force Multiplier, 98
Force Projection, 100
Foreign Exchange and Foreign Trade Act (FEFTA), 315
Foreign Exchange Rate Variation (FERV), 266
Foreign Military Sales (FMS), 280
Foreign Policy Concept of the Russian Federation, 186
Form-fit-functionality-firing, 286
Fostering Jointness and Interoperability, 102
Foundation for Advancing Science and Technology (FAST India), 290
France, 4, 39, 55, 164, 204, 228, 280
Free and Open Indo-Pacific (FOIP), 318
Funding support for Make-I Projects, 248
Future-Proofing the Military, 98

Gas Turbine Research Establishment (GTRE), 223
Gaza, 22, 25, 34, 38-39, 204, 207-09
  War, 21, 26, 170
GE-404 Engines, 222
Geopolitical Awareness Imperative, 124
Geopolitical Tensions, 95
Gerasimov, Gen Valery, *Military Affairs Courier*, 26,
  The Value of Science is in the Foresight, 26
German Federal, 40
German V 2 Missile, 163, 165
Germany, 39, 111, 162, 164, 208, 242, 304
Ghana, 36, 148
Ghor, 45
Ghormade, S.N., 9
Ghost Units, 153
Gill, Amb. Amandeep Singh, 143
Glenn Amendment, 280
Global Combat Air Programme (GCAP), 314, 320
Global Defence R&D Trends, 244
Global Gateway, 199, 200
Global Models of Balancing Manpower and Technology, 99
Global Partnership on Artificial Intelligence Summit, 142
Global Partnerships, 94
Global South, 184
Goldwater-Nichols Act, 72
Government of India (GoI), 14, 63, 68-69, 266-67, 269, 284, 290, 297-98
Government-to-government (G2G) Cooperation, 317
Grare, Frédéric, 12
Gray zone, 24
Great Britain, 180
Great Power War, 21
Greater Eurasia, 184
Greater Europe, 184
Greeks, 161
Green Channel Certification (GCC), 274
Gross Domestic Expenditure on Research and Development (GERD), 243
Gross Domestic Product (GDP), 242
Group of Governmental Experts (GGE), 143
Group of Ministers Report, 81
GSAT, 65, 98
Gulf, 185
Gulf Cooperation Council (GCC), 183
Gulf of Aden, 118, 122, 198
Gulf of Guinea, 198

Guwahati, 67

Hafiz Gul Bahadur (HGB) Group, 41, 43
Hamas, 2, 39
Hamre, John J., 72
Hansa-New Generation (Hansa-NG), 229
Harbin Engineering University, 257
Harbin Institute of Technology, 257
Hawk, 303
Hayat Tahrir al-Sham (HTS), 34, 43
Headquarters Integrated Defence Staff (IDS), 233
Hebrew University, 258
Helsinki Decalogue, 185
Helsinki Final Act, 186
Hercules, 279
Heyns, Prof., 142
High Altitude Pseudo Satellite (HAPS), 231, 235
High Council for the Unity of Azawad (HCUA), 36
High-altitude Long-endurance (HALE) UAV, 235
Higher Education Institutions (HEIs), 243
Himalayan Border, 181
Himalayas, 21, 23
Hindustan Aeronautics Limited (HAL), 222, 227-28, 237, 246
Hindustan Jet Trainer-36 (HJT-36), 227
Hindustan Lead-in Fighter Trainer-42 (HLFT-42) Aircraft, 223
Hindustan Turbo Trainer-40 (HTT-40), 227
Hindustan-228, 228-31, 238
Hostomel Airport, 129, 132
Houthi, 2, 97
Houthis' Attacks, 121
Hovhannisyan, 11
Hovhannisyan, Artsrun, 10
Hughes Precision, 211
Human Capital Development, 90, 102
Human Rights Council, 143
Human Trafficking, 120
Hybrid Warfare, 88
Hypersonic Cruise Missile (HCM), 168-69, 172
Hypersonic Glide Vehicle (HGV), 167-68, 172
Hypersonic Speed, 167

Ibn Rushd-Goethe Mosque in Berlin, 40
Ibrahim al-Qosi, 39
Icarus, 161
iDEX Prime Schemes, 246, 270
iDEX SPRINT, 271
iDEX4Faujis, 270
Idlib, 34
IIFL Securities, 290
Illegal, Unreported and Unregulated (IUU) fishing, 120, 122
Impact of Israel-Palestine Conflict, 282
Impact on Arms and Equipment Sourced from Russia, 281
Imperial College, London, 257
Improvised Explosive Devices, 120
Incentivise Higher Indigenous Content, 249
India, 9, 12, 15, 27, 54, 56, 58, 65, 74, 101, 107, 112, 164, 179, 181, 183-84, 186, 188, 195-96, 198, 200-01, 210-14, 226, 233, 236, 241, 243, 251, 267, 280, 287, 289, 292, 302, 320
  and EU Responses, 198
  Ideas Conclave 2024, 309
  post-1998 Nuclear Tests, 283
India's Brahmos, 168
India's Defence Budget, 107
India's Record of Jointness in War, 74
India-China War, 74
India-EU
  Cooperation, 199
  Industrial Defence Cooperation, 200
  Joint Declaration on International Terrorism, 196
  Strategic Partnership, 196
Indian Air Force (IAF), 64, 66, 222, 228, 230-32, 236, 279, 303
Indian Armed Forces, 7-8, 69, 71, 88, 90, 92, 95, 98, 101, 103, 104, 212
Indian Army (IA), 64, 211, 25, 228
Indian Coast Guard, 231
Indian Council of Agricultural Research, 243
Indian Defence Industry, 15
  Role, 297
Indian Institute of Science (IISc), 252
Indian Institutes of Science Education and Research (IISERs), 253
Indian Institutes of Technology (IITs), 253
Indian Multi-Role Helicopter, 229
Indian Navy (IN), 64, 66-67, 121, 123, 198, 224-26, 229, 232-33, 235, 279

Indian Ocean Naval Symposium, 185
Indian Ocean Region (IOR), 120, 181-82, 185, 194-95, 197, 199
Indian Ocean Rim Association, 185
Indian Space Research Organisation (ISRO), 65, 102, 261
India-Pakistan Wars, 23
Indigenization vs. Global Partnerships, 94
Indigenization, 100-01
Indigenous Content (IC), 266, 302-04, 308
Indigenously Designed, Developed and Manufactured (IDDM), 266, 268, 272-74
Indo-China War 1962, 277
Indonesia, 212
Indo-Pacific, 183
Indo-Pak War 1965, 75, 78
Information Management and Analysis Centre (IMAC), 97
Information Superiority, 61, 98
Information Warfare, 88, 266
Infrastructure Development, 103
Initial Operational Clearance, 228
Innovations for Defence Excellence (iDEX), 13-14, 246, 249, 266-68, 297-98, 305
INS Sharda, 97
INS Sindhughosh, 279
INS Sumedha, 97
INS Vikrant, 279
Integrated Air and Missile Defence (IAMD), 121
Integrated Capability Development (ICAD), 68
Integrated Clothing Management System (ICMS), 67
Integrated Material Management On-line System (IMMOLS), 66-67
Integrated Victualling Management System (IVMS), 67
Integration of the Digital System (IDS), 66
Intellectual Property Rights (IPR), 230, 260, 273, 275
Intelligence, Surveillance, and Reconnaissance (ISR), 26, 89-90, 121
Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR), 232
Intelligence-Led Warfare, 100
Inter Service Coordination, 122
Intercontinental Ballistic Missiles (ICBMs), 98, 163
Interface Control Documents (ICDs), 286
Intermediate Jet Trainer (IJT), 227-28
Internal Security, 95
International Law, 186
Interoperability with Allies, 62
Inter-service Cooperation, 62
Inter-Services Organisations (Command, Control and Discipline) Act, 83
Iran, 22, 27, 46, 206, 315
Iran's Fars and Kerman, 46
Iranian Shahed, 170
Iran-Iraq War, 164
Iraq, 165
Ireland, 204
Iron Swords war, 207, 213
Islamabad, 43
Islamic Emirate, 44
Islamic State, 21, 33-34, 39, 47
Islamic State Khorasan Province (ISKP), 39-40, 44-46
Islamic State Sahel Province (ISSP), 36
Islamic State West Africa Province (ISWAP), 35-36
IS-Mozambique, 37
Israel, 4, 13-14, 99-100, 164, 203-07, 209-10, 212-13, 244-45, 255, 258
Israel Aerospace Industries (IAI), 208
Israel Defense Forces (IDF), 2, 204-05, 208-09
Israel's Elbit Systems, 210
Israel's Iron Dome system, 98
Israel-Hamas war, 1, 15
Israeli Air Force, 207
Israeli Defence Forces (IDF), 100
Israeli-Palestinian conflict, 206
Israel-Palestine conflict, 34
Italy, 320

Jackson Model, 72-73
JADO, 153-54
Jaguar, 234
Jai Anusandhan, 248
Jaishankar, Dr S., 309
Jamaat Ahle Sunnat lid-Dawati wal Jihad (JASDJ), 34
Jamaat al-Nusrat al-Islam wal-Muslimeen (JNIM), 36
Jamaatul Ahrar (the JuA), 42
Jamiat Ulema-e-Islam-Fazl (JUI-F), 45
Jammu and Kashmir, 2

Japan, 4, 16, 112, 148, 180, 183, 304, 311-12, 314-21
Japan Air Self-Defense Force, 313
Japan's Ministry of Defense, 316
Japan-Australia, 318
Japanese Defence Industry in Transition, 313
Japanese Ministry of Defense, 16
Japan-US Alliance, 16, 317
Jerusalem, 204, 213
Jerusalem Will Not Be Judaized, 38
Jihadist, 33-34, 37, 46
Joint Doctrine, 84
Joint Fibre Optics Research Centre, 257
Joint Logistics Nodes (JLN), 67
Joint Planning, 122
Joint Theatre Command, 69
Joint War-Fighting, 71
Joint/Theatre Commands, 68
Jointness, 64, 79-80, 90
  and Integration, 101
  Elements, 80
  in the Armed Forces, 82
  vs. Service-Specific Priorities, 94

Kabul, 45
Kahneman, Daniel, 9
Kakodkar-Saraswat Committee, 271
Kalam, Dr A.P.J. Abdul, 301
Kalam Vision: Dare to Dream, 305
Kandahar, 45
Karachi, Sindh, 41
Karak, 45
Kargil Conflict, 76, 78, 81, 84, 92, 277-78
Kargil Review Committee, 81, 110, 290
Karnataka, 221
Kaveri Aero-engine, 13, 221
Kaveri Derivative Engine (KDE), 223, 237
Kaveri Engine, 237
Kazuto, Prof. Suzuki, 315
Kelkar Committee, 272, 305, 307
Kenya, 148
Khorasani, Abu Saad Muhammad, 45
Khorasani, Omar Khalid, 42
Khyber Pakhtunkhwa, 43, 45
Klein, Gary, 9
Knowledge (*épistémé*), 127
Korean War, 53
Kortunov, Andrey, 11
Kosovo, 23
Kremlin, 186, 188
Kunduz, 45
Kyiv, 119, 129, 131

Lake Chad, 35-36
Lal, Air Chief Marshal P.C., 75
Land Warfare, 266
Larsen and Toubro (L&T), 247
Latin America, 200
Lebanon, 204, 207-08
Less Dependence on US Arms, 281
LGBTQ+ Pride Parade, 40
Light Combat Aircraft (LCAs), 13, 221-25, 235, 237, 303
Light Combat Helicopter (LCH), 228
Light Utility Helicopter (LUH), 228-29
Limited Defence Budget, 94
Line of Actual Control (LAC), 24, 88
Lisbon, 184
Lloyd Austin, 207
Lockheed Martin, 242
Logistics for Protracted Wars, 27
London, 163
Long-Term Perspective Plans, 67
Long-Term Integrated Perspective Plan, 67
Low Technology-low Risk, 286

M/s Airbus, 287
M/s Tata Advanced Systems Limited, 287
M2M, 64
Mach 5, 168
Machine learning (ML), 133-34
Macron, Emmanuel, 204
Madrid, 181
Maintenance, Repair and Overhaul (MRO), 225, 231
Make, 273-75
Make in India, 13, 211, 241, 284
Maldives, 65
Mali, 36
Malik, General, 77
Manekshaw, Field Marshal Sam, 101
Manned Unmanned Teaming (MUMT), 120
Manohar Parrikar Institute for Defence Studies and Analyses (MP-IDSA), 5
Manpower Intensity, 93
Manpower vs. Modernization, 93
Marine Corps, 62, 72
Maritime, 2

Maritime Capability Perspective Plan, 123
Maritime Domain Awareness (MDA), 122
Maritime Warfare, 117
Martens Clause, 146-47
Mass-Based Strategy, 100
Massed Fires and Precision Strikes, 26
Mastung, 45
Mauryan Empire, 91
MDO, 153-55, 157
Mediterranean Sea, 161
Medium Altitude Long Endurance (MALE) UAV, 172
Medium Transport Aircraft (MTA), 231
Meghana River, 76
Merkel, Angela, 196
Micro, Small and Medium Enterprises (MSMEs), 241, 246, 248, 271, 297
Middle East, 23, 161, 166, 170, 180, 183, 185, 206-07, 212
MiG, 225, 234, 279
Militancy, 46
Military Civil Fusion (MCF) Policy, 100
Military Experience, 127
Military Industrial Ecosystem, 275
Military Integration, 62
Military Jointness, 62
Military Purchasing Power Parity (PPP), 107
Minimum Order Quantity (MoQ), 124, 272
Ministry of Defence (MoD), 3, 8, 82, 233, 250, 252, 256, 268, 272-73, 290, 297, 302, 306, 308, 312-13, 318
Ministry of External Affairs, 283
Ministry of Finance (MoF), 272
Ministry of War, 42
Mirage-2000, 234
Miscategorisation between Make-I and Make-II, 274
Mishra, Brajesh, 77
Missile Technology Control Regime, 280
Mission DefSPACE, 270
Mission-Based Deployments, 122
Modernization Imperative, 93
Modi, Narendra, 64, 67, 142, 179, 184, 187-88, 303
Mongolia, 148
Morocco, 148
Mosaic Warfare, 154
Moscow, 179-84, 187-88, 195-96
Moscow's Crocus City Hall, 46
Motivation, 123
Mozambique, 37, 197
Mughal Empire, 91
Mukherjee, Anit, 71-72, 75
Multi-Domain Integration, 90
Multi-Domain Operations Preparedness, 103
Multi-Domain Operations, 25
Multi-Domain Warfare, 266
Multi-Layered/Complex Wars, 154
Multinational Joint Task Force (MNJTF), 35
Multi-Role Fighter Aircraft (MRFA), 226
Mumbai, 67
Munitions India Limited (MIL), 210-12
Mutual Assured Deterrence (MAD), 163
Myanmar, 23, 180

Nagorno Karabagh War, 170, 292
Nangarhar, 45
Nanjing University of Aeronautics and Astronautics, 257
Nanjing University of Science and Technology, 257
Narang, R.K., 13
National Aeronautics and Space Administration (NASA), 252, 285
National Aerospace Laboratory (NAL), 229
National Deep Tech Startup Policy, 244
National Defense Industrial Strategy (NDIS), 316
National Defense Strategy (NDS), 311, 321
National Frequency Allocation Plan-81 (NFAPF-81), 65
National Institutes of Technology (NITs), 253
National Logistics Policy (NLP), 66-67
National Movement for the Liberation of Azawad (MNLA), 36
National Pride, 96
National Research Foundation (NRF), 248
National Security Advisor (NSA), 77
National Security Mechanism, 69
National Security Strategy (NSS), 22, 311, 314, 319, 321
Natural Disasters, 95
Natural Resources, 292
Nature of Warfare, 88
Naval Fighter Development Programme, 223
Naval Innovation and Indigenisation Organisation (NIIO), 123, 246
Naval Satellites, 65

Naval Utility Helicopter (NUH), 270
Navy, 62, 68, 102
Nawaz Sharif, 76
Necessity of Technological Integration, 124
Need for Jointness, 94
Need for Separate Naval Fighter (TEDBF), 225-26, 235
Neighbourhood First, 65
Nepal, 65
Net Effective Exchange Rate (NEER), 109
Netanyahu, 209
Network-Centric Warfare (NCW), 97, 99
New Delhi, 76, 179-88, 195-96, 198-99, 204, 210, 213
New Russian Nuclear Doctrine, 56
New START Treaty, 54
Niger, 36
Nikkei Asia, 315
No First Use (NFU), 57
Non-lapsable Defence Modernisation Fund, 109
Non-NATO (Warsaw Pact signatory) State, 282
Non-physical Domains, 28
Non-Resident Indians (NRIs), 283
Non-State Actors, 89
North and South Waziristan, 45
North Atlantic Treaty Organization (NATO), 15, 54-56, 144, 180-81, 182, 184, 186, 211, 282, 292, 320-21
North East, 89
North Korea, 22, 27, 54, 168, 320
North Waziristan, 43
Northeast Asia, 181, 184
Northrop Grumman, 242
Northwestern Polytechnic University, 257
NPC (network-platform-centric), 154
NPT, 53-54, 57

Oceania, 23
Ofakim, 208
Official Security Assistance (OSA), 312, 319
Oman, 148
One Way Attack Drones (OWAD), 170, 172
Operation Cast Lead, 209
Operation Eagle Claw, 72, 81
Operation Protective Edge, 209
Operation Urgent Fury, 72
Operational Advantage, 98
Operational Efficiency, 97
Operational Environment, 128, 130, 132
Ordnance Factory Boards (OFBs), 251, 268
Organization for Security and Co-operation in Europe (OSCE), 185
Organization for the Prohibition of Chemical Weapons (OPCW), 53
Original Equipment Manufacturers (OEMs), 66, 222, 234-35, 273, 301
Orpheus 703 engine, 235
Ouagadougou, 36
Overseas Private Investment Corporation, 280
OWADs, 170

P-75(I) Programme (submarines), 270
Pacific Ocean, 181, 182
Pacific, 200
Pakistan, 7, 39, 43-44, 46, 54, 57, 89, 148, 182, 196, 210
Pakistan Navy, 121
Pakistani Taliban, 34, 41, 43
Pakistan-occupied Kashmir, 89
Paris Indo-Pacific Ministerial Meeting, 198
Paris, 204
Pascal Vennesson, 9
Patil, Jayant, 14
Patriot Air Capability 2 (PAC 2), 165
Pegasus, 161
Peloponnesian War, 126
People's Liberation Army (PLA), 24
Persian Gulf, 118
Persons of Indian Origin (PIOs), 283
Petraeus, General David, 87
Pigou, Arthur, 294
Pinaka Rockets, 212
Plassey, 92
Political Declaration on Responsible Military Use of Artificial Intelligence and Autonomy, 143
Port Blair, 67
Positive Indigenisation Lists (PILs), 267, 297
post-9/11, 47
post-Cold War, 1, 10, 52, 195
post-Galvan Stand-off, 267
post-World War II, 52
Power Projection, 96
Prakash, Admiral Arun, 224
Precision and Effectiveness, 96
Precision Firepower, 118
Precision Guided Munitions (PGM), 171

Precision Strike Capabilities, 99
Precision Strike, 89
Price Inflation, 296
Principles of Responsible Use, 144
Private Sector Incentives Increase, 248
Private Sector Investment in R&D, 247
Production Diplomacy
    Multilateral Collaboration Lessons from the Ukraine Response, 316
Production Linked Incentive (PLI), 249
Professionalising Acquisition, 269
Project Management Unit (PMU), 269
Project Sanction Order (PSO), 273
Proliferation of Tactical Drones, 121
Protracted Wars, 296
Psychological Deterrence, 96
Psychological Warfare, 122
Public Procurement (Preference to Make in India) Order 2017, 267
Putin, Vladimir, 54, 56, 167, 179, 182-83

QinetiQ, 256
Quadrilateral Security Dialogue (QUAD), 16, 180, 187, 319
Qualitative Military Edge, 100
Quality and Cost Based Selection (QCBS), 249, 273
Quality Assurance (QA) Reforms, 273-74
Quality Requirements (QRs), 227
Quetta, 45

Radhakrishnan, Nabanita, 14
Rafah Operation, 205
Rafale, F-35, 225, 280
Rafale Marine (Rafale-M) fighter jets, 226
Raghavan Committee, 305
Raksha Udyog Ratna (RUR), 268-69, 275
Rapid Adaptation, 100
Rapid Mobilization and Deployment, 95
Rapid Response, 97
Rapid Technological-Tactical Innovation, 121
Raytheon, 242
REAIM Blueprint, 148
Real Effective Exchange Rate (REER), 109
Red Fort, 63, 64
Red Sea, 2, 97, 118, 121
Reduced Collateral Damage, 96
Reduced Personnel Costs, 97
Re-entry Vehicle (RV), 167-68
Remotely Piloted Strike Aircraft (RPSA), 13, 221, 232, 237
Republic of Korea, 144, 148
Research and Development (R&D), 2, 5-6, 9, 13-15, 17, 81, 103, 107, 110-12, 119, 123, 241-46, 248-52, 258, 261, 266, 269, 284, 290-91, 293, 297-98, 299, 302, 305-08, 312, 314
    Expenditure in India, 243
Resource Angle, 293
Resource Efficiency, 63
Resource Optimisation, 61
Responsible Artificial Intelligence in the Military Domain (REAIM), 144
Return on Investment (ROI), 261-62
Revolution in Military Affairs (RMA), 28, 68
REW (Radio-electronic Warfare), 155-56
Rightsizing the Force
    Strategic Imperative, 101
Roadmap to 2025, 196, 198
Robotics, 28, 97-98
Rolls-Royce, 256
Rotary Wing Drones (RWD), 160, 167, 171-73
Rubin. Uzi, 11
Rudenko, Maj. Vitalii, 130
Russia, 4-5, 7, 12, 21-22, 24, 27, 40, 54-56, 89, 107, 129, 131, 168-69, 179-80, 183, 185-86, 188-89, 193, 200, 208, 222, 226, 278-79, 295, 304, 320
Russia's Su-57, 166
Russia-Belarus Union State, 183
Russia-India relations, 179
Russian Fleet, 155
Russian Geran 2, 170
Russian Jamming Systems, 155
Russian 'Lancet', 170
Russian-Ukrainian War, 2, 10, 15-16, 55, 118-19, 120, 154, 170-71, 184, 278, 304, 312, 315-16
Russia-US Trade, 188

Sabherwal, Rajeev, 8
Sachdeva, Rajeev, 7
Sadamasa Oue, 16
Sahel, 33-34, 36
Samir Gupta, 8
Sanctions and their Impact, 280
Sanctions, 296

Sanctions, Short-lived, 281
Saras Mk-1 and Mk-2, 230, 236
Saudi Arabia, 165, 211-12, 302
Saudi-Houthi War, 166
Sayf al-Adl, 39
Sea Harrier, 224
Sea Lines of Communication (SLOCs), 194-95, 197
Self-Defense Forces (SDF), 311, 320
Self-reliance, 16, 94, 111, 230, 286, 290, 301, 304, 308
Semiconductor Complex Limited (SCL), 309
Serbia, 23
Service-Specific Focus, 94
Seven Sons of National Defence, 256
Seventh Pay Commission, 110
Shanghai Cooperation Organisation (SCO), 183, 185, 187
Shapiro, Jacob and Liam Collins, *War on the Rocks* commentary, 23
Shekau, Abubakar, 34
Ships taken Up from Trade (STUFT), 122
Short-Range Unmanned Aircraft Vehicle (SRUAV), 231, 237
Singapore, 148
Singh, Rajneesh, 6
Single party acquisition under IDDM, 274
Sino-British, 257
Six-Day War, 24, 205, 207
SM65 Atlas, 163
Smaller Force, 97
Smith, Kristian E., 73
SMPP Limited, 211
Solar Industries Limited, 211
Solid State Physics Laboratory, 253
Somalia, 37
South Asia Satellite, 65
South Asia, 7, 46, 184-86, 211
South Asian Association for Regional Cooperation (SAARC), 65, 183
South Caucasus, 180, 185
South China Sea, 21, 23-24
South Korea, 4, 13, 111, 180, 242, 311
Southeast Asia, 5, 183-84
Soviet Ground Based Air Defence (GBAD) Systems, 165, 170
Soviet Union, 23-24, 53-54, 163
Space as a Warfighting Domain, 89
Space Warfare, 266
Spain, 204, 230
Special Purpose Vehicle (SPV), 273
Speed and agility, 61
Speed of Operations, 118
Sri Lanka, 65
SRIJAN Portal, 267
Srinagar, 74
St. Stephen's Cathedral, 40
Standing Committee on Defence, 305
Starmer, Keir, 204
Start-ups, 101, 248-49, 267, 271, 312
Stealth Wing Flying Testbed (SWiFT), 232
Stockholm International Peace Research Institute (SIPRI), 23, 210, 212, 302
Strait of Hormuz, 122
Strategic Flexibility Requirement, 124
Strategic Investments in Technology, 102
Strategic Partnership Model (SPM), 241, 266, 270
Strategic Thinking, 63
Strategy on Defense Production and Technological Bases, 313
Strategy, Statecraft, and Technology (Changing Character of War) Centre (SST-CCW), 27
Streamline procurement processes, 249
Strengthen industry-academia collaboration, 248
Su-30/33, 225, 234, 303
Suicide UAV, 169-70
Suicide Vehicle Born Improvised Explosive Device (SVBIED), 43
Summi (like Kharkiv), 156
Supersonic Cruise Missile, 168, 212
Supply Chain, 296
Suppression of Enemy Air Defences, 133
Surface Warfare, 266
Surgical Procedure, 83
Swavalamban, 14
Syria, 34
System Improvement Group (SIG), 66

Taiwan, 315, 320
Tajiks, 40
Talent Development and Skill Building, 248
Tapas, 232, 235, 237
Tapas Medium-altitude Long-endurance (MALE), 13, 221
Tata Advanced Systems Limited (TASL), 229, 236, 238, 247, 303

Tax Incentives for R&D Expenditure, 249
Tech-intensive Forces, 97
Technion, Haifa, 258
Technological
  Advancement, 61, 98
  Convergence, 100
  Dominance, 99
  Edge, 98
  Integration, 90
  Leverage, 97
  Synergy, 63
Technology Development Acceleration Cell (TDAC), 123, 246
Technology Development Fund (TDF), 13-14, 246, 249, 267, 271, 298, 305
Technology Force Multiplier, 101
Technology Perspective and Capability Roadmap (TPCR), 67
Technology Readiness Levels (TRLs), 14, 252
Tehreek-e-Jihad Pakistan (TJP), 43-44
Tehreek-e-Taliban Pakistan (TTP), 41-42, 44
Tel Aviv, 210
Tel Aviv University, 258
Territorial Army, 68
Territorial Control, 95
Terrorist organizations, 89
Thales (Belgium), 211
the Netherlands, 144, 148
the Philippines, 180, 212
The Washington Post, 130
Three Principles on Transfer of Defense Equipment and Technology' and its Implementation Guidelines (Three Principles and IG), 312, 315, 319
Three Services, 63-67, 69
Thucydides, 126-28, 134
Tiger Hill, 76
Tnufa, 153
Togo, 36
Toofan al-Aqsa operation, 38
Top-Down Capability Dominant, Threat cum Mission, 123
Trade Off, 93
Transfer of Technology (ToT), 222, 228-29, 233-34, 236-37, 267, 302-04
Turkiye, 43, 46
Tversky, Amos, 9
Twain, Mark, 23
Twin Engine Deck Based Fighter, 13, 221
Ukraine, 2, 21-23, 25, 38, 54-58, 73, 119, 132, 161, 170, 184, 208, 211, 213, 278, 291-92, 295, 304, 321
Ukraine War, 26, 30, 57, 79, 173, 318
Ukrainian 'FPV' Drones, 155
Ukrainian Armed Forces, 155
UN Human Rights Council, 142
Uncrewed Air Vehicle, 164
Uncrewed Surface Vessels, 119
Underwater Warfare, 266
Unified Logistics Interface Platform (ULIP), 66
Union of Soviet Socialist Republics (USSR), 195, 279
United Kingdom (UK), 14, 55, 147-48, 162, 165, 180, 204, 255-56, 279, 320
  Ministry of Defence, *Ambitious, Safe, Responsible*, 144
United Nations, 321
United Nations (UN) Special Rapporteur on Extrajudicial, Summary or Arbitrary Executions, 142
United Nations General Assembly, 10, 143, 144
United Nations Security Council, 2, 205
United States (US/USA), 1, 4-7, 13-16, 21-24, 36, 46, 53-58, 72-73, 76-77, 81, 99-100, 107, 111-12, 153, 162-63, 168, 180-83, 185, 194-95, 205-07, 209, 213, 222, 227, 242, 244, 252, 255, 278, 280, 292-93, 295, 304, 306, 311-12, 316-18, 321
  'Switchblade', 170
  Aid to Israel, 206
  Congress, 205
  DARPA Programs, 98
  Department of Defense, 316
  Department of State, 280
  F 22 and the F 35, 166
  Indo-Pacific Command, 73
  Military Aid, 206, 209
  Patriot Air Defence System, 165
  Patriot System, 166, 167
  Replicator, 320
United States Department of Defense, Ethical Principles for Artificial Intelligence, 144
University Affiliated Research Center (UARC), 255
University of Electronic Science and Technology of China (UESTC), 257
University of Glasgow, 257

University of Manchester Graphene Aerospace Material Centre, 257
University of Manchester, 257
University of New South Wales in Australia, 257
Unmanned Aerial Systems (UAS), 65-66, 155-56
Unmanned Aerial Vehicles (UAVs), 10, 100, 119, 160, 165-67, 169, 172, 210, 221-22, 231, 235
Unmanned Combat Aerial Vehicles, 65
Unmanned Systems, 26
Upsala Study Data Program, 23
User Service/Designated Office, 273
US-India, 318
US-initiated Indo-Pacific Economic Framework, 188
US-Israel Relationship, 205
US-Japan Leaders' Statement, 315
US-led Global War on Terror, 1
US-Philippines security partnership, 181
Uzbeks, 40

Vajpayee, 76
Varma, D.B. Venkatesh, 7
Vast Borders, 95
Vietnam, 23, 212
Vijay Kelkar Committee, 269
Vinci, Leonardo Da, 161
Vladivostok, 184

Wakeley, 39
Wallonia, 40
War of Independence, 207
Warfare, 128
Washington, 180-83, 204-05, 213
Washington's East Asia Allies, 184
Washington-Tokyo-Seoul Cooperation, 181
Weapons of Mass Destructions (WMDs), 3, 52
Weizmann Institute, Rehovot, 258
West, 27, 34, 38, 39, 44, 182, 214
West Africa, 33-34
West Asia, 1-2, 5, 265
Western Alliance, 21
Western States, 148
West-Russia Crisis, 186
What went WRONG?, 269
White House, 188
Whole-of-nation Approach, 285
Wilayah (shadow provinces), 41
World Defense Show 2024, 212
World War II, 10, 21, 53, 71, 92, 162-65, 173, 196, 255, 311
Worldwide Interbank Financial Telecommunication (SWIFT), 283

Xi Jinping, 318

Yedai, Maj. Gen. Tamir, 209
Yemen, 197
Yoav Galant, 207
Yom Kippur War, 24, 207

Zaluzhnyi, General Valerii, 130
Zeppelins, 162
Zone Balancing, 12, 185

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