DRONE WARFARE IN RUSSIA-UKRAINE CONFLICT: MYTHS, REALITY, AND LESSONS FOR INDIA

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INTRODUCTION

'Drone' is a broad term commonly used to describe any unmanned platform, from a small consumer-grade quadcopter to a large, sophisticated military vehicle. Unmanned Aerial Vehicles (UAVs) and other uncrewed platforms[1] have been used in various forms since World War I. However, it is in the Russia-Ukraine conflict that drones seem to have carved a niche for themselves, as evidenced by the scale of their employment, the scope of their roles and the speed of doctrinal evolution. While it may be too early to judge whether the current employment of drones is an enduring phenomenon or simply a transitory phase born out of a specific context, militaries do not have the luxury of waiting for the final doctrinal outcome. Translating a technology into a hard military capability is a long gestation endeavour. The investment in a technology required to fight wars in the

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1. Apart from drones, other uncrewed platforms include Unmanned Surface Vessels (USVs), Uncrewed Underwater Vehicles (UUVs), Remotely Operated Vehicles (ROVs), and Autonomous Uncrewed Vehicles (AUVs).

next decade must start now. To that extent, the combat zone in the Russia-Ukraine conflict has become an all-encompassing veritable microcosm of drone warfare that is being studied by all military experts to develop a cogent vision for the employment of drones in future warfare. This article intends to systematically examine the employment of drones in this war and analyse the emerging realities with a view to distill lessons for military planners for future force structuring. At the same time, the paper will also try to assess and underline the need for India to utilise these emerging technologies for planned restructuring of forces in the wake of Operation Sindoor.

Within a few days of the initiation of the war with Ukraine in February 2022, images of Russian tanks destroyed by unmanned platforms like the Bayraktar TB2 began to flood social media.[2] The Bayraktar was also credited with playing a significant role in the sinking of the Russian flagship cruiser *Moskva* on April 14, 2022, when it was employed with Neptune anti-ship missiles in a hunter-killer configuration.[3] However, by the end of the year 2022, UAVs like the Bayraktar (Turkey) and Kronshtadt Orion (Russia) were effectively out of the battle as Russia introduced potent Electronic Warfare (EW) and Air Defence (AD) systems. The evolutionary cycle of drone warfare in this conflict is fast and getting further compressed leading to quick obsolescence and emergence of new platforms and tactics. Small numbers of bigger, expensive and potent platforms have made way for the induction of numerous low-cost commercial drones like the DJI Mavic 3 employed to overwhelm traditional AD and EW systems by their sheer numbers and variety. In turn, faster frequency analysers and jammers have been introduced by both sides, forcing innovators to go back to the drawing board time and again. This classical contest between the sword and the shield has shortened

2. Brett Forrest and Jared Malsin, "Ukraine Says It Used Turkish-Made Drones to Hit Russian Targets", *Wall Street Journal*, February 28, 2022, https://www.wsj.com/livecoverage/russia-ukraine-latest-news-2022-02-26/card/ukraine-says-it-uses-turkish-made-drones-to-hit-russian-targets-DrigGO7vkGfDzbBuncnA. Accessed on July 14, 2025.
3. David Hambling, "Ukraine's Bayraktar Drone Helped Sink Russian Flagship *Moskva*", *Forbes*, April 14, 2022, https://www.forbes.com/sites/davidhambling/2022/04/14/ukraines-bayraktar-drones-helped-destroy-russian-flagship/?sh=31839a9e3a7a. Accessed on July 13, 2025 .

the average operational life of a drone to a few weeks.[4] Clearly, the doctrinal establishment of drones as an enduring instrument to fight modern wars is still evolving.

EVOLUTION OF DRONES IN RUSSIA-UKRAINE CONFLICT

The Russia-Ukraine conflict saw the induction of a large variety of drones ranging from commercial off-the-shelf models to purpose-built military systems. Table 1 below lists out the prominent UAV models that have been extensively used by Russia and Ukraine in the ongoing conflict.

Table 1: List of Prominent Drones Used in Russia-Ukraine Conflict

Russian Military Drones						
S. No.	**Name**	**Type**	**Wg Span (Ft.)**	**Range (Miles)**	**Endurance (Hrs)**	**Remarks**
1.	Orion (Inokhodets)	MALE	48	155	24	Missiles Strikes ISR
2.	Mohajer-6	MALE	33	90	6	Armed
3.	Forpost Forpost – R (UCAV Version)	MALE	28	140	17	Licensed version of Searcher Mk-II (Israel)
4.	Korsar	MALE	21.3	130	10	Missile 9 M120 & 9 M113
5.	Zala 421	MALE	16	65	12	Multirole
6.	Granat Series	Fixed Wing	10.5	40	06	ISR

4. Kateryna Bondar, "The Russia-Ukraine Drone War: Innovation on the Frontlines and Beyond", *CSIS*, May 28, 2025, https://www.csis.org/analysis/russia-ukraine-drone-war-innovation-frontlines-and-beyond. Accessed on July 19, 2025.

7.	Orlan-10 & Orlan –30 (Multiple Variants)	Fixed Wing	10	100 to 550	5 to 18	**Multirole** ISR, EW Strike Arty Fire Direction
8.	Zala 421 HD	Multiple Variants	9.2	50	4	**Multirole** ISR Strike
9.	Zala 421-16E		9.2	30	4	
10.	Zala 421-16E2		9.2	20	4	
11.	Shahed 131/136/ Geran-2 (Russian version)	Kamikaze Med Class	9	1000	3 to 24	Deep Attack
12.	Lastochika	Quadcopter	8	30	2	ISR & Strike
13.	Eleron-3/10 (Multiple variants)	Fixed Wing	7.2	28	2	Multirole ISR Light Strikes
14.	Tachion	Tac Cl	7	20	2	ISR
15.	Zastava	Tac Cl	7	10	2	ISR
16.	Zala 421-16 EM	Hybrid	5.9	15	3	ISR & Strike
17.	Lancet-3	Fixed Wing Kamikaze	5.5	40	40	Precision Strike
18.	Sibir – 1	Small Cl	4.5	6	1	ISR
19.	Griffon	Small Cl	NA	5	3	ISR
20.	KUB-BLA	Fixed Wing Kamikaze	NA	30	NA	Precision Light Strike
21.	Supercam S-350	Fixed Wing	3.2	120	4.5	ISR
22.	Tyuvik	Autonomous	NA	50	4.5	AI Powered Strike
23.	VT-40	FPV Drone	10	15.5	3	Interceptor Drone

24.	Bee Drone	Carrier Drone	33	27	1.5	FPV Deployment Radio Relay
25.	Night Witch	Hexacopter	19.6	90	4 to 8	Carry Four Bombs
26.	Kovrovet-1	Disposable fixed-wing drone	NA	7.5	1.3	Light Strikes
27.	Molniya, Privet	FPV Attack drones	5	15	0.40	Light Strikes Swarm
28.	Swarm Drones	Autonomous swarm drones	60	50	20	Coordinated Strikes
29.	Kvazimachta	Tethered quadcopter	5	25	24	ISR Radio Relay
30.	Fiber-Optic Drones	Quadcopters		10		ISR Light Strike

Ukrainian Military Drones						
S. No.	**Name**	**Type**	**Wg Span (Ft.)**	**Range (Miles)**	**Endurance (Hours)**	**Remarks**
1.	Bayraktar TB2 (Turkey)	MALE	39	190	27	ISR Precision Strike
2.	PD Series (People's Drone)	Fixed Wing Modular	13	60-100	7	Multirole
3.	Flyeye	Mini	12	20	2	ISR
4.	Scan Eagle	Small	10.2	60	18	ISR Light Strike
5.	Spectator M-1	Short Rg	10	35	2	ISR Light Strike
6.	RQ-20B Puma	Small	9.2	10	3	ISR Light Strike

7.	Vector	Short Rg	9	20	3	ISR Light Strike
8.	Punisher	Fixed Wing	7.5	26	2	Strike (75 mm Bomb)
9.	A1-CM Furia	Fixed Wing	7	30-80	3	ISR Arty Direction
10.	Mini Bayraktar	Small	6.5	10	2	ISR Light Strike
11.	Raven Rq-11	Small	4.5	5	1	ISR Light Strike
12.	UJ-26 Bober	Fixed Wing	22	620	7	Deep Attack
13.	Mugin 5 Pro	Fixed Wing	16.5	550	7	Deep Attack
14.	UJ 22 Airbourne	Fixed Wing	14	500	6	Deep Attack
15.	TU 141 Strizh	Fixed Wing	13	600	6	Deep Attack
16.	TU 143	Fixed Wing	7.5	110	NA	ISR Deep Attack
17.	Morok (RZ-60)	Med	5	200	NA	Deep Attack
18.	Switch Blade 300/600 (USA)	Kamikaze	4.3	25 to 45	40 Mins	Strike
19.	R-18	Octocopter	-	60	45 Mins	Light Strike Thermal Imaging
20.	Baba Yaga (Vampire)	Hexacopter	-	10	25 Mins	Strike (10-15 Kg explosive)
21.	DARTS (Multiple Variant)	Fixed Wing FPV	-	15	30 Mins	Precision Strike

22.	Corvo-PPDS (Australia)	Fixed Wing Disposable	9	75	3	Deep Attack Cardboard Drone
23.	Leleka-100	Fixed Wing	6	50	4	ISR Arty Direction
24.	Autel EVOII (China)	Quadcopter	-	10	40 Mins	ISR
25.	GOGOL-M Mothership Drone	FPV Carrier	NA	190	NA	Drone Carrier Radio Relay AI Powered

Source: *Compiled by the authors*.

The evolution of drone warfare in the Russia-Ukraine conflict can be divided into three overlapping phases in terms of technology, tactics and operational impact. In the early phase (February-May 2022), Ukraine used the Bayraktar TB2 (Turkey) for precision strikes against Russian armour and supply lines with devastating effect. Russia relied on its indigenous Medium Altitude Long Endurance (MALE) UAV Orion (Inokhodets) for surveillance and direction of artillery fire. When it became untenable to operate these larger models in the dense AD environment, both sides adapted commercial quadcopters like the DJI Mavic series for reconnaissance and low intensity attacks like dropping grenades. The middle phase (June 2022 to December 2023) commenced as the war gradually metamorphosed into a battle of attrition along static frontlines from June 2022 onwards. Both sides significantly scaled up employment of drones, losing about 10,000 drones per month, as estimated by the British military think-tank, Royal United Services Institute (RUSI) in May 2023.[5] Russia introduced Iran's Shahed-136 (Russian version, Geran-2) kamikaze drones for massed attacks on Ukraine's energy and water infrastructure, while Ukraine fielded First Person View (FPV) drones for precision strikes in the Tactical Battle Area (TBA). Effectively,

5. David Hambling, "New Report: Ukraine Drone Losses Are '10,000 Per Month'", *Forbes*, May 22, 2023, https://www.forbes.com/sites/davidhambling/2023/05/22/ukraine-drones-losses-are-10000-per-month. Accessed on July 18, 2025.

While private ventures in Russia developed some innovative models, bulk production of drones like the Geran-2 (optimised Shahed-136) took place in the government's Alabuga Special Economic Zone (SEZ), located in the Republic of Tatarstan in southwest Russia.

by using drones, Russia compensated for the lack of adequate Precision Guided Munitions (PGMs) like the Iskandar-M missiles and Ukraine compensated for limited availability of ammunition for the High Mobility Artillery Rocket System (HIMARS).[6] This phase saw rapid expansion of the indigenous drone industry in Ukraine, led by the private sector's Small and Medium Enterprises (SMEs). While private ventures in Russia developed some innovative models, bulk production of drones like the Geran-2 (optimised Shahed-136) took place in the government's Alabuga Special Economic Zone (SEZ), located in the Republic of Tatarstan in southwest Russia.[7] This phase also witnessed the deployment of better EW systems (Russia's Repellent, Ukraine's Bukovel-AD) along with a variety of defensive (cope cages, multi-spectral camouflage) and hard-kill counter-measures using kinetic shots and nets. The current phase (January 2024 till date) has witnessed significant technological upgrades, resulting in the introduction of rudimentary autonomy, experimental swarm, fibre-optic drones, interceptor drones, along with increased production rates. Both sides have introduced innovative models powered by Artificial Intelligence (AI) and computer vision with pre-loaded terrain data to continue operations in a Global Positioning System (GPS) denied environment. Ukraine tested the AI-powered Gogol-M Mothership Drone (May 2025) that launches 400 smaller FPVs for a coordinated attack at a range of 190 miles. Similarly, Russia fielded the Tyuvik (series production commenced in May 2025) that uses neural networks for autonomous target

6. HIMARS is the High Mobility Artillery Rocket System developed by the United States which is mobile and can launch multiple precision guided rockets or a singular tactical missile.
7. "Who is Making Russian Drones?", *Global Initiative*, May 8, 2025, https://globalinitiative.net/analysis/who-is-making-russias-drones/. Accessed on July 17, 2025.

recognition and navigation.[8] Russia was able to employ a group of two to six drones, with limited autonomous swarm features for coordinated attacks. Russia was also the first to introduce fibre-optic drones to avoid jamming and spoofing, albeit with increased instances of cable entanglement while operating at low levels. Operational induction of Unmanned Surface Vehicles (USVs) for targeting Russia's naval assets was another major success for Ukraine. The Magura V5 USV not only sank the Russian warship, *Sergey Kotov* in Sevastopol[9] but when equipped with air-to-air missiles (R-73, Sidewinder), it is claimed to have shot down a Russian MI-8 helicopter.[10]

Russia's successes in the battles of Bakhmut, Avdiivka, and Severodonetsk depended heavily on drone-enabled precision artillery strikes and real-time force adjustment by virtue of battlefield transparency provided by ISR drones.

Drones made their impact felt throughout the battlefield, ranging from forward defences to strategic depth. In fact, currently, drones are inflicting more casualties in the rear as compared to the frontlines. While the TBA was flushed with a variety of drones providing Intelligence, Surveillance, Reconnaissance (ISR) and strike support, both sides developed capabilities to strike deep. Ukraine's Palianytsia and UJ-26 Bober launched attacks on strategic targets hundreds of miles inside Russian territory. Russia used the Shahed-136 and the Lancet Loitering Munition (LM) for deep attacks as well as for precision attacks on the Ukrainian S-300, Buk and HIMARS deployed in operational depth. Notably, Russia's successes in the battles of Bakhmut, Avdiivka, and Severodonetsk depended heavily on drone-enabled precision

8. "The Battlefield AI Revolution Is Not Here Yet: The Status of Current Russian and Ukrainian AI Drone Efforts", *Understanding War*, June 2, 2025, https://understandingwar.org/backgrounder/battlefield-ai-revolution-not-here-yet-status-current-russian-and-ukrainian-ai-drone. Accessed on July 15, 2025.
9. Isabel van Brugen, "Crimea Naval Drone Attack Destroys Russia's Newest $65M Patrol Ship", *Newsweek*, March 5, 2024, https://www.newsweek.com/sergey-kotov-patrol-ship-crimea-destroyed-drones-1875844. Accessed on July 14, 2025.
10. Ibid.

artillery strikes and real-time force adjustment by virtue of battlefield transparency provided by ISR drones.[11]

A recent study by RUSI conducted from mid-2024 to February 2025, estimated that drones were responsible for 60 to 70 per cent of damaged or destroyed Russian military systems during this period.[12] While the frontlines have remained static with occasional shallow thrusts by motorcycle/ATV (All Terrain Vehicle) borne small teams through gaps identified by the ever present 'drone-line' of ISR and FPV drones maintaining 24×7 vigil. The study found that the effectiveness of UAVs is often limited by weather and EW systems that results in almost 60-80 per cent of FPVs either being destroyed or failing to reach their targets. Both Russian and Ukrainian frontline forces make extensive use of UAVs for situational awareness while remaining within protective bunkers. Any movement outside concealed positions is met with an immediate response from loitering FPV platforms or Optical Fibre Cable (OFC) tethered drones. From an organisational standpoint, dedicated ISR battalions and independent UAV companies have now been formally integrated under divisions and brigades respectively. In effect, both sides have moved beyond adaptive Techniques, Tactics, and Procedures (TTPs) to fully institutionalising the employment of drones as an integral component of both doctrinal planning and organisational design. Such doctrinal adaptations and TTPs of drone warfare born out of actual combat experience of many years are invaluable lessons for all armed forces around the world.

Speaking at the Shangri-La security forum in Singapore on May 31, 2025, Ukraine's Deputy Defence Minister Oleksandr Kozenko stated that Ukraine now produces 10 million drones per year, and that drones are now responsible

11. Ali Cenk. "Russian Operational Art for Attrition in Ukraine" *Turkish Journal of War Studies*, vol. 5, no. 1, 2024, pp. 90-128, https://dergipark.org.tr/en/pub/tws/issue/84290/1467513. Accessed on July 17, 2025.
12. Jack Watling and Nick Reynolds, "Tactical Developments During the Third Year of the Russo–Ukrainian War ", *RUSI*, 2025, https://static.rusi.org/tactical-developments-third-year-russo-ukrainian-war-february-2205.pdf.

for 80 percent of all battlefield attacks.[13] Meanwhile, in an unprecedented move to bolster its Eastern flank, the North Atlantic Treaty Organisation (NATO) has launched the "Drone Wall" initiative, led by Germany.[14] The project envisages an 1,150-miles-long drones-based surveillance network extending from Norway to Poland. Such assessments and initiatives are shaping global operational precepts as the Russia-Ukraine conflict continues to serve as a live laboratory of drone warfare.

REFLECTIONS AND INSIGHTS

The Drone World Congress Expo in May 2025 featured a spectacular drone show in which thousands of drones danced in a tight tango as they created precise digital images from fairy tales that lit up the night sky.[15] While spectators were fascinated by the show bordering on science fiction, such incredible level of autonomy sent chills down the spines of military minds. Imagine thousands of drones in a coordinated autonomous swarm attacking a battalion-defended area. Even if half of them were to get destroyed by counter-measures, the balance would still be enough to decimate any defensive position. While in theory, it is a perfectly plausible proposition, in reality, such sophistication does not yet exist in the contested combat environment of the Russia-Ukraine conflict.

Autonomous Drones and Swarms: Truly autonomous drone swarms need a huge bandwidth to exchange large telemetry data at high speed. Similarly, autonomous drones require advanced sensors, processors and data storage that prohibitively increase their cost and complexity. Moreover,

13. "Drones are the New Weapon of Modern Warfare—Here's How Ukraine Mastered Their Production and Can Now Make 10 Million a Year", *The Economic Times*, June 2, 2025, https://economictimes.indiatimes.com/news/international/us/drones-are-the-new-weapon-of-modern-warfare-heres-how-ukraine-mastered-their-production-and-can-now-make-10-million-a-year-ukraine-news-russia-news/articleshow/121576197.cms?from=mdr. Accessed on July 20, 2025.
14. Rosemary Poetr, "NATO's $110 Billion Gamble: This 1,850-Mile Drone Wall Is the Most Expensive Military Barrier in History", *Sustainability Times*, April 26, 2025, https://www.sustainability-times.com/policy/natos-110-billion-gamble-this-1850-mile-drone-wall-is-the-most-expensive-military-barrier-in-history/. Accessed on September 6, 2025.
15. "10th Drone World Congress", August 5, 2025, https://droneworldcongress.com/en-US/NewDetails/619. Accessed on September 6, 2025.

complex terrain, changing tactics, decoys, EW systems and specialised maintenance requirements make them practically unsuitable for generic combat application.[16] Hence, truly autonomous drone swarms have not yet witnessed combat application because of their vulnerability to EW systems, and their logistic complexity, limited endurance and payloads. However, coordinated massed application and successful sensor-shooter arrangements for precision strikes are the harbingers of more autonomy and deployment of larger swarms in the future.

Concept of Operation (CONOPS): Analysis suggests that in the Russia-Ukraine conflict, the combat effectiveness of drones did not come from platform capability, rather, it emerged from the creative CONOPS designed around the basic principles of war like surprise, simplicity, security, concentration and mass. Some examples where simple UAVs were employed to obtain disproportionate combat outcomes was the use of Unmanned Surface Vehicles (USVs) by Ukraine to inflict damage on Russia's Black Sea Fleet; USVs mounted with the R-73 Surface-to-Air Missiles (SAMs) that shot down Russian helicopters; and coordinated sequential attacks on tanks by multiple FPVs. The acme of creative planning and execution of a deep attack was 'Operation Spiderweb' wherein the Ukrainians used commercial FPV drones to inflict damage worth billions on Russia's strategic bomber fleet.[17] Similarly, use of OFC tethered drones played a significant role in the battle of Kursk, and mass use of cardboard drones as decoys along with the Shahed-136 and Iskandar-M missiles provided better outcomes to Russia in deep attacks. Effectively, combat outcomes suggest that success in drone warfare comes more from creative employment rather than the potency of the platform.

High-Tech vs Low-Tech: The core competence and battlefield leverage of drones being employed in the Russia-Ukraine conflict is derived from their

16. n. 8.
17. Katja Bego, "Ukraine's Operation Spider's Web is a Game-Changer for Modern Drone Warfare. NATO Should Pay Attention", *Chatham House*, July 2025, https://www.chathamhouse.org/2025/06/ukraines-operation-spiders-web-game-changer-modern-drone-warfare-nato-should-pay-attention. Accessed on September 7, 2025.

low cost, simplicity of operation, minimal training and mass application. As a drone gets loaded with sophisticated sensors, higher payload, AI tools and redundant navigation features, it starts resembling a cruise missile in both cost and complexity. In the current operational context, such high-tech drones lose their unique battlefield leverage that comes from the redundancy provided by mass application. Increased platform capability does not necessarily provide commensurate battlefield advantage. However, that is not to assert that high-end unmanned platforms are redundant. New generation high-tech platforms being developed by leading militaries as loyal wingmen necessarily have to match the speed, manoeuvrability and payload of manned fighter aircraft to fulfil their defined role. Similarly, new generation platforms being fielded by China like the hypersonic recce UAV and stealth Unmanned Combat Aerial Vehicle (UCAV) capable of flying at 50,000 ft, are key battle-winning elements of a future battlefield.[18] Since, the notion of military victory is ultimately a function of cost exchange ratios, in the case of the Russia-Ukraine conflict, the sheer numbers of low-cost, tactical drones have come to define the day-to-day conflict, while high-end, expensive UCAVs are often reserved for specific, high-value missions. Therefore, it can be surmised that a force structure characterised by a balanced mix of high and low technology is likely to give optimal dividends.

Force Replacement vs Force Augmentation: **The** Russian Ka-52s used the Orlan-10 in the Manned-Unmanned Teaming (MUM-T) configuration to successfully launch stand-off attacks with guided Kh-39 LMUR (Light Multipurpose Guided Rocket) missiles from a range of 15 km on Ukrainian positions in Kursk.[19] The Ukrainian Bee drone relayed signals from FPV drones to support helicopter operations. Russia's tank forces integrated

18. Abhishek Kumar Darbey, "China's Increasing Global Drone Footprint", Manohar Parrikar Institute for Defence Studies and Analyses, November 21, 2024, https://www.idsa.in/publisher/comments/chinas-increasing-global-drone-footprint-2. Accessed on September 7, 2025.
19. Gareth Jennings, "Ukraine Conflict: Russia's Attack Helicopter Forces Transition from 'Easy Target' to 'Worst Nightmare'", *Jane's*, February 27, 2025, https://www.janes.com/osint-insights/defence-news/defence/ukraine-conflict-russias-attack-helicopter-forces-transition-from-easy-target-to-worst-nightmare. Accessed on September 7, 2025.

Russia initiated the conflict with large scale, multi-front thrusts, using conventional forces, and captured huge swathes of territory within days. As the initial push lost momentum, Russia adapted its posture to protect its territorial gains by creating formidable defensive lines.

with the ISR drones and Lancet LM for detection of anti-tank teams and guiding strikes beyond line of sight. Similarly, both sides extensively used drones for direction of artillery fire to achieve First Salvo Effectiveness (FSE) and precision strikes without using expensive PGMs. All these examples and their combat outcomes suggest that instead of replacing tanks, guns or helicopters in their basic roles, drones increased the combat effectiveness of these conventional platforms through integration in the kill-chain. In the context of Network-Centric Warfare (NCW), drones have provided low-cost precision and stand-off capability to the legacy platforms, which were previously not available at the tactical level. Hence, drones should be integrated as a force multiplier at both tactical and operational levels rather than being employed in a stand-alone manner.

Operational Context: The politico-military objectives and operational-strategic context within which Russia and Ukraine are operating favours the choice of drones as the primary tools. Russia initiated the conflict with large scale, multi-front thrusts, using conventional forces, and captured huge swathes of territory within days. As the initial push lost momentum, Russia adapted its posture to protect its territorial gains by creating formidable defensive lines. Hamstrung by numerous economic, political, military and demographic constraints, both sides largely reconciled to static World War I style trench warfare, with shallow opportunistic incursions. In such an operational context, drones have assumed centrality as the platform of choice for cost-effective harassment and attrition of the adversary. Moreover, in the case of Ukraine, the choice of drones as a cost-effective indigenous resource is more of a *fait-accompli* in view of its dependence on the West for military requirements. The emergence of static lines and the lack of manoeuvre resulted in the war being fought at a tactical level, with a limited role of operational art and strategy. War at the tactical level was, thus, strengthened by the fusion of digital communications, mass data collection and rapid dissemination for decentralised operations by real-time drone employment. Social media, commercial navigation and satellite intelligence supported a short decision-action loop at the tactical level, thereby cementing the role of UAVs as central platforms for the entire range of battlefield activity.[20] Drones can play a primary role where the politico-military objective is to punish and harass. However, in the case of a large-scale conflict between near-peer adversaries, wherever force is used in pursuit of significant political objectives to be realised through decisive operations, there is no alternative to heavy firepower and mass manoeuvre. In such scenarios, drones will play a supporting role to increase the combat efficiency of traditional platforms. Hence, large scale employment of drones, much like any other military capability, needs to be seen in this specific context. Any generalised inferences drawn from the current conflict for future force structuring could prove to be a mistake unless properly contextualised in specific and realistic scenarios.

The Russia-Ukraine conflict is characterised by employment of drones across strategic, operational and tactical levels.

Multi-Level Application: The Russia-Ukraine conflict is characterised by employment of drones across strategic, operational and tactical levels. Drones have provided – hitherto not available—integral ISR capability at the sub-tactical level (section/squad/platoon level) allowing them to function efficiently in a battlefield defined by decentralised and directive style command. Similarly, resources to launch low intensity stand-off attacks in tactical depth, minor logistic support, and combat search and rescue were not available at the sub-tactical level before the advent of drones. At the operational level, drones have been integrated with tanks, helicopters and

20. Serhii Yevtukh, "Security Service of Ukraine: Key Operations and Challenges During the Full-Scale Russian-Ukrainian War", The Central Research institute of the Armed Forces of Ukraine, vol. 2, no. 4, 2024, pp. 137-147, https://themilitaryscience.com/index.php/journal/article/download/106/136.

artillery to achieve more effective outcomes. At the operational strategic level, Russia uses massive waves of the Zeran-2 and other low-cost decoys to improve the outcomes of missile strikes. Then there are instances like Operation Spiderweb, where tactical drones have been used to achieve strategic effects. If the current conflict is any indication, then it is clear that drones have established themselves at every level of warfare either by filling an existing capability void or by enhancing the efficacy of legacy platforms.

Counter-UAS—Integral to Drone Warfare: The Counter-Unmanned Aerial System (CUAS) is indeed an integral part of drone warfare. Both sides have effectively used EW systems in multiple configurations, ranging from manpack versions to truck mounted high-power jammers to temporarily deny the intended area of operations to enemy drones. As a 'hard kill' option to defend against drone attacks, both sides use anti-aircraft and machine guns, with a high rate of fire as a cost-effective solution instead of expensive SAMs. Ukraine uses the Short-Range Air Defence (SHORAD) Systems like the Gepard, a German self-propelled 35mm anti-aircraft gun with radar that can detect and track small, fast-moving targets. More expensive air defence systems like the National Advanced Surface-to-Air Missile System (NASAMS), Patriot, S-300 and Buk-M are mainly deployed to protect only high-value targets. Typical large-scale saturation attacks executed by Russia consist of a mix of low-cost cardboard drone decoys, Shahed-136 and Surface-to-Surface Missiles (SSMs) that can overwhelm any CUAS effort. The conundrum of speedy and foolproof Identification of Friend and Foe (IFF) and cost-effective weapon-to-target-matching remain major challenges. Future warfare will need AI powered CUAS systems with capability to speedily classify incoming projectiles followed by interception or destruction using Directed Energy Weapons (DEWs) like High-Power Microwave (HPM) and High-Energy Laser (HEL). China recently unveiled a number of such systems (LY-1 HEL and Hurricane 3000 HPM)[21] during the

21. Joseph Trevithick, "China's Imposing LY-1 High-Power Laser Weapon Unveiled At Huge Military Parade", *The War Zone*, September 3, 2025, https://www.twz.com/news-features/

military parade held on September 3, 2025. Hence, a mix of hard kill, soft kill and passive counter-measures like multi-spectral camouflage, concealment, deception and dispersal have typically defined the CUAS strategy on the frontlines in Ukraine.

Organisational Culture: Another enduring lesson to be learnt from this conflict is about the role that organisational culture plays in achieving combat success. Time and again, it was observed that the Ukrainian drones produced results far beyond their designed capability. It was primarily because Ukraine consistently stayed ahead of the obsolescence curve by fielding better models with innovative Tactics, Techniques and Procedures (TTPs). The Russian frontline troops were always reacting to these initiatives. The Ukrainians could achieve this because of decentralised force structures and close coordination between military operators and civilian producers of drones. On the industry side, drone production is led by SMEs which are not encumbered by the bureaucracy of large defence corporations. At the same time, the Russians were slowed by their centralised control over design, development and production as well as doctrinal dogma in the employment of drones in the TBA. Although Russian private ventures also got mobilised in due course, leading to technical innovation like OFC tethered drones, which brought them out of proportion dividends in the battle to liberate the Kursk region. Hence, decentralised structures, lean organisations and close coordination among the military, academia and industry, without bureaucratic bottlenecks are essential for agile adaptation to emerging operational scenarios. Secondly, development of drone capability necessarily needs to be based on self-reliance, affordability, innovation culture, decentralisation and large-scale participation of SMEs.

Information Warfare (IW): The video of a Russian soldier surrendering to a Ukrainian drone or a Russian T-72B tank destroyed by a few low cost FPVs, shaped more powerful narratives on social media than an unseen Multi-Barrel Rocket Launcher (MBRL) wiping out an entire platoon in a single

chinas-imposing-ly-1-high-power-laser-weapon-unveiled-at-huge-military-parade. Accessed on September 7, 2025.

salvo. Such narratives were fought with symmetric counter-narratives by the Russians on Telegram showing a successful drone swarm or spectacular show of mass attack with hundreds of Shahed-136s lighting up the night sky over Kiev or Lviv. Thus, in the Russia-Ukraine War, embedded journalists were replaced by drones playing the roles of both the executor and reporter of an Information Warfare (IW) event. Thus, though the popular perception of drones being the centrepiece of combat success, as shaped by these IW events, may not be universally true, drones will continue to be significant for IW in future combat because of their ability to telecast combat events in real-time.

Space-Based Assets: The effective use of USVs to target Russia's Black Sea Fleet highlights a few larger issues for policy-makers. USVs used by Ukraine are nothing more than explosives-laden small boats in which the main component is a powerful satellite terminal provided by SpaceX Starlink. Targeting imagery for such operations is provided by other commercial entities like Maxar Technologies, Planet Labs and Black Sky.[22] Firstly, such attacks are fraught with huge escalation risks as use of third-party commercial satellites to execute military operations makes such satellites legitimate military targets, especially for an adversary with proven anti-satellite capability. Secondly, satellites will play a significant role for successful employment of drones, LMs and PGMs for deep attacks in future wars. Space-based systems like GPS, GLONASS[23] and NavIC (India), provide precise Positioning, Navigation, and Timing (PNT) data for drones, enabling accurate targeting, navigation and autonomous operations. Without satellite PNT, the precision and autonomy of drones are severely limited, especially in contested environments where ground-based navigation is unreliable.

LESSONS FOR INDIA: RUSSIA-UKRAINE CONFLICT

22. Theodora Ogden, et al., "The Role of the Space Domain in the Russia-Ukraine War: The Impact of Converging Space and AI Technologies", Centre for Emerging Technology and Security, February 23, 2024, https://cetas.turing.ac.uk/publications/role-space-domain-russia-ukraine-war. Accessed on July 10, 2025.
23. Russian Global Navigation Satellite System.

The employment of drones in the Russia–Ukraine conflict offers several significant lessons that hold universal relevance for the Indian armed forces. Drones have largely become the essential force multipliers that have the ability to catalyse all aspects of battlefield domination. Drones are now an integral, and not optional, part of force structures for persistent reconnaissance, rapid target acquisition, precision strike, battle damage assessment, logistics, and psychological operations. Drones function as critical multi-domain enablers for attrition, information dominance and harassment. Adaptive organisation and creative doctrine bring decisive dividends instead of mere possession of high-tech drones. Ukraine's decentralised network allowed faster adaptation, bringing greater dividends at lower costs. At the same time, the Russian response was deliberately slow but structured and large scale (mass production and employment), which generated strategic effects but at a high cost. Both aspects are essential for quicker adaptation followed by institutionalised responses to generate effects of the desired scale on the battlefield. AI powered CUAS systems with capability to speedily classify incoming projectiles, followed by cost-effective interception with advanced directed energy weapons will be essential for survivability on the future battlefield. While saturation attacks by low-cost drones have proved effective, at the same time, the relevance of high technology UCAVs and other legacy platforms like tanks, helicopters, cruise missiles or artillery has not reduced. As per a latest study by RUSI[24], the maximum threat to the Ukrainian forces in the last six months has been posed by 'glide bombs'[25] launched by Russian fighters from stand-off distances, and not by drones. Thus, the best results are achieved through the integrated employment of all platforms, in line with the time-tested

24. Jack Watling and Nick Reynolds, "Tactical Developments During the Third Year of the Russo–Ukrainian War ", RUSI, 2025, https://static.rusi.org/tactical-developments-third-year-russo-ukrainian-war-february-2205.pdf. Accessed on September 7, 2025.
25. Glide Bombs: Russia is using modified Soviet-era bombs, equipped with wings and satellite guidance, to strike Ukraine. Known as "glide bombs," they are cheaper and more plentiful than cruise or ballistic missiles. Weighing 500 to 3,000 kg, these weapons are dropped from beyond Ukraine's air defences and can devastate even fortified positions, contributing to recent Ukrainian setbacks in the east.

While the West has outrightly supported Ukraine with equipment, ammunition, intelligence and planning, China, Iran and North Korea have rallied behind Russia.

principles of weapon-target matching and optimal mix. No modern force can operate at scale without robust drone capabilities. The psychological effect of the constant, unpredictable presence of hostile drones, on the frontlines as well as the rear areas leads to battle fatigue and affects the morale of both the combatants and civilian populations. Thus, the significant role of drones in psychological operations aimed at undermining the adversary's will highlights their emergence as a truly multi-domain instrument of warfare.

Future of Warfare: In order to translate the abovementioned lessons for designing future force structures, it is imperative to prognosticate on the nature of future wars that India is likely to fight. The ongoing proxy war in Ukraine between Russia and the West since February 2022, and the region-wide turmoil in the Middle East have confirmed the return of large-scale conventional war in the international political discourse.[26] The confluence of several factors suggests that the phenomenon of '*total war*' is likely to be the new normal in conflicts across the world. 'Total war' is characterised by the proxy involvement of numerous states aligning behind the main adversaries. While the West has outrightly supported Ukraine with equipment, ammunition, intelligence and planning, China, Iran and North Korea have rallied behind Russia. Even in the brief Indo-Pak skirmish, Pakistan was directly supported by China during Op Sindoor.[27] The second aspect of total war relates to the breakdown of "*the continuum of conflict*". War was neatly categorised into a spectrum defined by two ends consisting of low

26. Mara Karlin, "The Return of Total War: Understanding—and Preparing for—a New Era of Comprehensive Conflict", *Foreign Affairs*, November-December 2024, https://www.foreignaffairs.com/ukraine/return-total-war-karlin. Accessed on September 7, 2025.
27. Ashok K Kantha, "The New Battle Challenge of China-Pakistan Collusion", *The Hindu*, July 7, 2025, https://www.thehindu.com/opinion/lead/the-new-battle-challenge-of-china-pakistan-collusion/article69780786.ece. Accessed on September 7, 2025.

intensity (terrorism and insurgency) at one end and conventional war, with the nuclear hangover, at the higher end. Recent conflicts worldwide suggest that while 'nation-states' have returned to war, powerful non-state actors have not retreated from the scene. In fact, non-state actors have been integrated into the conventional strategies. All three recent conflicts viz; Russia-Ukraine, Israel-Iran and Op Sindoor reflect these attributes of war characterised by the participation of state and non-state actors in simultaneous pursuit of hybrid and conventional strategies. Therefore, it is no surprise that tools like low-cost drones that earlier were weapons of choice for weaker non-state actors have now been adopted by conventional forces. In such an era of total war, India will not only need full spectrum capabilities provided by an optimal mix of high technology and low-cost platforms, but also new doctrines and strategies to deal with low and high-end threats that will manifest simultaneously in multiple domains. 'Total war' also changes the deterrence paradigm wherein the weakness in any of the domains (land, sea, air, cyber, space and information) and at any end of the spectrum (sub-conventional to nuclear) can be exploited by the adversary. Thus, a one-sided argument advocating the dominance of low-cost drones over other high technology expensive platforms could prove to be a dangerous miscalculation. Therefore, India needs to structure a drone force that can be applied across the entire spectrum within the paradigm of total war.

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CONCLUSION: CONSTRAINTS AND OPPORTUNITIES

War is an enduring phenomenon of political interaction amongst nation-states as conflicts are rooted in basic human psychology defined by power, control, fear, honour and greed. The notion of victory in a war is defined by relatively higher damage inflicted on the enemy in terms of men, material and territory. Thus, keeping warriors out of harm's way has been the holy grail of military planners. Primary weapons of primitive warfighting like swords gradually made way for spears, slingshots, arrows, machine guns and missiles, in pursuit of stand-off capability for non-contact warfare. Completely removing the man from the battlefield is the acme of this pursuit. Hence, future wars being fought solely by intelligent unmanned platforms is an inevitable extrapolation of this eternal trend. Keeping this ultimate aspiration in mind, it is imperative to create an integrated drone capability that generates credible deterrence to dissuade adversaries and provide optimal efficacy in combat.

India faces a complex security environment with China's AI-enabled massive drone force designed for "intelligentised warfare" and Pakistan's low-cost asymmetric warfare strategy. China deploys over 1,000 advanced UAVs, including hypersonic and multi-role stealth platforms duly complemented by advanced directed energy weapons-based CUAS systems. It has indigenously developed over 50 different drone platforms and is projected to have a stockpile of one million loitering munitions by 2026. Unmanned platforms like the Jiu Tian drone carrier, an 11-ton UAV mothership that can launch swarms of 100 drones, have no equivalent. The Pakistan military operates both High Altitude Long Endurance/Medium Altitude Long Endurance (HALE/MALE) UAVs, including around two dozen UCAVs. It leverages close partnerships with Turkish and Chinese sources for assured supply chains for its low-cost drone arsenal, designed to inflict asymmetric costs. Its strategy includes transfer of drones to non-state actors, thus, manifesting the spectre of total war.

India's response to the collusive drone challenge posed by China and Pakistan has been characterised by incremental progression, constrained by dependence on foreign procurements, and shaped by the emerging indigenous initiatives. Robust policy measures like liberalisation of drone regulations and incentivisation of the domestic drone industry through schemes like Innovations for Defence Excellence (iDEX) and the Production-Linked

Incentive (PLI), have shown promising results. Nonetheless, it is noteworthy that India's entire operational UAV fleet consisting of the Searcher, Heron, Hermes and MQ-9 Sea Guardian is of foreign origin. This dependency creates critical supply chain vulnerabilities while simultaneously inhibiting the maturation of indigenous design and manufacturing capacities. In contrast, both Russia and Ukraine, faced with the imperatives of sustaining a protracted war, were compelled to expand and consolidate substantial indigenous drone design and production capabilities. Secondly, India's domestic manufacturing base and Research and Development (R&D) efforts remain fragmented, thereby inhibiting capacity for production of military-grade sensors and high-performance microchips of the required scale and quality. India needs to develop indigenous capability for producing AI-enabled platforms, robust communications modules, advanced sensors, stealthy designs and redundant navigation suites through public-private partnerships under a long-term policy framework and an overarching organisation to guide these efforts. India must integrate the adaptive agility demonstrated by the Ukrainian military with the structural robustness of the Russian model to develop a formidable, drone-centric force. In practical terms, the following aspects are critical for building such a capability. In a paradigm of drone warfare characterised by low cost and high attrition, resilience is derived from reserves. Consequently, maintaining adequate stockpiles of critical components is essential to absorb losses and enable surge production to maintain operational momentum.

What is needed is to establish a joint doctrine for layered, redundant and network-based air defence against high-end military drones/missiles as well as massed attacks using low-cost drone swarms. And to create an empowered organisation with executive authority to serve as the single nodal agency responsible for defining standards, prioritising R&D, incentivising industry, overseeing procurement, and ensuring doctrinal as well as operational integration. The holistic development of drone capabilities requires coordinated efforts by industry, academia, and military operators by dismantling bureaucratic silos. Developing a large pool of skilled drone operators is vital to harness the drone capabilities. Such training needs to be realistic; based on joint exercises in drone-saturated environments to test concepts and foster continuous innovation.