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## **The Military Lessons of the Russia-Ukraine War**

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# Introduction

**T**he Russia-Ukraine war remains at a deadlock despite both sides working to gain an upper hand on the battlefield. This requires an examination of how the capabilities of both sides have been used since Moscow's foray in late February 2022.

The invasion was preceded by Russia's 2014 annexation of Donetsk and Luhansk, which are part of the Donbas region of eastern Ukraine, as well as Crimea, a Russian-majority peninsular region. Notwithstanding the Minsk Agreements of 2014 or 2015—which called for a ceasefire, the complete withdrawal of all external occupying forces, and constitutionally mandated reform recognising the special status of Donetsk and Luhansk—Russian separatist forces and Ukrainian government forces continued combat in the Donbas from 2014 until February 2022.<sup>1</sup> In the case of Crimea, Russia held a referendum in March 2024 that supported its union with the Russian

Federation, but it was internationally deemed to be illegitimate.<sup>2</sup> From the moment Russia launched a full-scale invasion—or what President Vladimir Putin called a “special military operation”—on 24 February 2022, Moscow set itself up for failure with the ambitious goal of seizing Kyiv in a quest to decisively knock out Ukrainian forces by attacking along multiple land axes.

Throughout 2022, Ukrainian forces, militarily backed by the North Atlantic Treaty Organization (NATO), responded with an effective counteroffensive, retaking key towns and villages in Kherson in the south and regions in the north of the Dnipro River.<sup>3</sup> Kyiv also declared that it would take back all territory occupied by Russia since 2014. Ukraine, supported by the West, prepared for this through the initial months of 2023, eventually mounting a counteroffensive in June 2023 with the primary aim of cutting Russian supplies to Crimea.<sup>4</sup> However, the Ukrainian

counteroffensive, launched against well-prepared and entrenched Russian defences, proved costly for Kyiv as it repeated Russia's mistake of attacking along multiple axes.

The inability of either side to bring about a decisive end to the war can be partly attributed to the consistent and adequate relating of means to ends.<sup>5</sup> Objectives have been at odds with deployed capabilities. Western military aid in 2023 has not been robust enough to help Kyiv make additional breakthroughs. Russia has also not used the breadth of its capabilities to attain territorial gains, despite its declared objectives. Tactical and operational blunders have also compounded their failure to secure any consequential operational breakthroughs, let alone a decisive military outcome.

As of writing, the war is deadlocked, with minor tactical gains being made by both sides utilising certain innovations in combat. There is a need for greater engagement with and explanations about the capabilities that have been employed by both sides.

In Chapter 1, Arjun Subramaniam examines the underperformance of Russian airpower during the war despite Russia being seemingly well prepared in the run-up to the invasion in late February 2022. Subramaniam prescribes a need to

debate the means and methods for an air-denial strategy for limited and protracted wars, as well as investments in more robust cruise missile and drone capabilities.

Abhijit Singh, in chapter 2, notes how Moscow used its navy to disable the limited capabilities at the disposal of the Ukrainian navy, while Russia also employed its surface vessels and submarines to strike Ukrainian land targets in a quest to aid the Russian army's land campaign. He underlines a key lesson for India in the use of strategy and technologies and how they relate to doctrine.

Birender Dhanoa follows with an exposition of how the Russian army's use of armour has been ineffective because of its failure to use tanks as part of a combined arms force. For India, the lesson is in optimising the use of tanks alongside advances in electronic warfare systems, ATGMs, and unmanned aerial systems (UAS).

In Chapter 4, Amrita Jash contends that the Russia-Ukraine war has primarily been an artillery war rather than a contest of airpower. As the war has progressed, both sides are suffering from shortfalls in artillery munitions, which has contributed to slow advances on the battlefield for both sides. The lesson for India relates to the need to invest more in artillery.

In Chapter 5, Rajeswari Pillai Rajagopalan analyses the role played by space-borne assets in the war, especially in surveillance, navigation, and communication. Rajagopalan finds that, while space-borne assets have been used extensively by both sides, these alone cannot determine the tide of the war as they are only an enabler in warfighting.

Shimona Mohan closes the report with an examination of the role of artificial intelligence (AI) and cyber warfare in the hostilities. She illustrates how in the past, military innovations led to civilian and commercial applications, while today, there is a reversal of roles between the military and civilian technological ecosystems. Therefore, in India, cultivating and nurturing the civilian innovation ecosystem is as important as that for military technology.

Moscow overplayed its hand with a dramatic escalation of its war on Ukraine by mounting a full-scale invasion. Ukraine responded using the military aid provided by the West, pushing Russian forces further east and retaking 50 percent of the land area initially occupied by Moscow. At the time of writing, Russian forces retain control of most of the Donbas region and Crimea, which they occupied through proxies or directly in 2014; Ukraine is yet to retake these areas due to the consequences of the failed counteroffensive and robust Russian defences. Russian and Ukrainian forces remain locked in a stalemate, with neither making a significant breakthrough since Ukraine's failed counteroffensive in June 2023.



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# Weighing the Role of Air Power

Arjun Subramaniam

**D**espite Russia's continued technological prowess in aerospace power even after the demise of the Soviet Union, its military doctrine has seldom viewed airpower as a war-winning instrument. Consequently, even though Russia's aerial platforms and their associated engines, sensors, and weapons systems in most areas match those of the West, their operational exploitation in the Russian military has lagged because of a lack of doctrinal nimbleness and sophistication. This has impeded their effective integration into a joint war-fighting capability, as highlighted in its ongoing conflict with Ukraine.<sup>1</sup>

Meanwhile, for Ukraine, its Air Force (RUAG), developed as an offshoot of the Soviet Air Force, has remained largely stagnant. Perhaps the only notable development in recent years is the spurt in capability exploitation as a result of training provided by instructors and advisors from the United States (US) and other North Atlantic Treaty Organization (NATO) members in the years

following Russia's occupation of Crimea and other parts of eastern Ukraine in 2014. This chapter examines the underperformance of 'classical air power' and the disproportionate impact of drones in the ongoing war, and outlines broad lessons that India can draw from the conduct of the conflict.

## Underperformance of Classical Air Power

### Russia

The poor performance of the Russian military in the war with Georgia in 2008 resulted in far-reaching reforms that seemingly placed greater emphasis on combined-arms warfare, rapid reaction capabilities, and advanced Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) capabilities for better battle-space awareness. The greatest beneficiary of these reforms appeared to be the Russian Aerospace Forces (VKS). Among the capabilities that were added to the VKS was the procurement of nearly 400 new tactical aircrafts

and thousands of unmanned aerial vehicles (UAVs); modernisation of strategic bombers; addition of over 30 surface-to-air missile defence units, such as SA-20s and SA-21s; and acquisition of conventional precision-strike capabilities through air-launched cruise missile (ALCM), land-attack cruise missiles (LACM), and short-range ballistic missiles (SRBM). The Russian air force upgraded its Air Defence setup with long-range area-denial weapons systems such as the S-400s and upgraded its long-range air-launched precision capabilities by modernising its bomber fleet.<sup>2</sup>

The success of Russian air power in an uncontested aerial environment in the Syria Campaign led to the premature Western assumption that the VKS had emerged out of the shadow of the Russian army and evolved into a decisive element of joint warfare. However, recent events reveal that Russian military leadership continues to consider offensive air power only at the strategic and tactical levels; while the former is linked to nuclear response, the latter is linked with supporting a land offensive. The VKS's lack of conviction around the importance of traditional offensive power at the operational level for a successful ground campaign—which seeks to first suppress enemy air defences, wrest and maintain air superiority or create a favourable air situation, or shape the battlespace through interdiction—appears to have been validated in the conflict with Ukraine.

Putin and his military leadership's assumption that a mere show of force by Russian ground forces towards Kiev, with limited coercion along one axis, was sufficient to force a psychological capitulation of Ukrainian leadership backfired. The VKS also attempted its own campaign to achieve control of the air around Kiev through a limited counter-air campaign that included airstrikes by Su-24s, Su-35s, and Su-30 SM fighters and cruise missile strikes on several key Ukrainian airfields and missile sites.<sup>3</sup>

The dropping and landing of airborne forces around Kiev and Kharkiv in the opening weeks of the conflict indicated integrated operation. Sporadic and uncoordinated air strikes by VKS fighters and attack helicopters against tactical targets around Kiev were largely ineffective and resulted in significant losses, which included 20 Su-34s, 30 Su-25s, 33 KA-52s, and 11 Mi-28s. There was much public conversation that Russia was deliberately holding back the VKS in the hopes of forcing a quick Ukrainian surrender. When that failed, Russia was forced to open multiple fronts in eastern and southern Ukraine.

Simultaneously, the West rushed in massive military aid that included sophisticated air defence systems such as the Patriot, NSAM, Hawk, Stinger, and Javelin.<sup>4</sup> The Russian military then fell back to the old Soviet tactics of massed infantry and

armour, supported by artillery and long-distance fire vectors such as cruise missiles to try and restore order to their stalled offensives. This forced the VKS to abandon its conventional aerial offensive by the end of March 2022 and fall back on alternative aerial strategies that relied on drones as well as cruise and ballistic missiles to cause combat attrition and attack targets deep inside Ukraine—a strategy that has since gained momentum. However, according to Western sources, through much of 2023, the VKS has established local air superiority in eastern Ukraine.<sup>5</sup> In a recent setback for the Russians that has caused them to re-evaluate aerial strategies in Southern and Eastern Ukraine, three hi-tech SU-34 fighter bombers were downed in Southern Ukraine on 22 December 2023 in what the Ukrainians have called a ‘missile ambush’.<sup>6</sup> Apparently, the Russians got bolder and tried to come closer to the frontlines to deliver their stand-off glide bombs, only to be intercepted, in all probability, by a Patriot missile battery.

### **Ukraine**

Outnumbered and outgunned by the VKS at the beginning of the conflict, the offensive complement of the RUAG comprised 124 combat-capable aircraft: Su-24s, Su-25s, Su-27s, and Mig-29s.<sup>7</sup> The air defence component before Western aid arrived in March 2022 was made up of several batteries of S-300 missiles and a large complement of legacy Soviet systems that included SA-8, SA-10, and SA-

11. The RUAG benefited immensely from nearly five years of training with US and NATO military advisors and effectively established an air-denial strategy that blunted the VKS’s offensive strategy.

Adopting effective ‘shoot and scoot’ tactics during the early weeks of the war, Ukrainian Surface-to-Air (SAM) systems effectively countered Russia’s Suppression of Enemy Air Defences (SEAD) missions and caused significant attrition on VKS strike aircraft, which initially came in at medium altitudes (5–8 km). When the VKS switched to low-level attacks, they were regularly taken down by shoulder-fired missiles, also known as Man-Portable Air Defence Systems (MANPADS), such as the SA-8 and Stingers.<sup>8</sup> The RUAG has been unable to freely operate its own fighter aircraft over the Tactical Battle Area and in Russian depth areas due to the dense VKS air defence network. It has also struggled to preserve its assets, having lost almost half of its serviceable inventory of fighters to VKS SAMs and during aerial engagements with superior VKS fighters equipped with better air-to-air missiles. Consequently, Ukraine has also resorted to the large-scale use of drones, causing significant attrition to Russian military assets on land and at sea.

## The Impact of Drones

The Russia-Ukraine conflict marks a turning point in the use of Unmanned Aerial Vehicles (UAVs). It is too early to predict if it marks a paradigm shift in the way air wars are conducted in the future, considering the similar approaches of the VKS and the RUAG in air wars and the enormous drone losses on both sides.<sup>9</sup>

### Increasing Battlefield Transparency

While drones have caused much combat attrition on either side, discerning analysts argue that current and next-generation drones may not shift the offense-defense balance in their favour in a contested aerial environment.<sup>10</sup> However, over Ukraine, the areas that drones have been most effective in are increasing battlefield transparency and enabling accurate artillery fire. As noted by one Western analyst who regularly visits Ukrainian frontlines, “There is little room for ground manoeuvre and the moment tanks venture out of their harbours, they are effectively engaged by artillery or Anti-Tank Guided Missile (ATGM) equipped ‘shoot and scoot teams’, the latter being mainly employed by the Ukrainians.”<sup>11</sup>

While Russia has a clear advantage in terms of numbers, variety, and payload effectiveness, Ukraine has leveraged its existential threat and recruited hundreds of drone operators to assist formations in the field. Among the most widely used drones by Ukraine for surveillance and guidance are the Chinese DJI Mavic quadcopter, whereas Russia has used the Orlan-10, Eleron, and Zala drones for tactical reconnaissance, with the larger Orion drones used for longer missions.<sup>12</sup>

### Direct Attack

In the initial stages of the war, both Russia and Ukraine used larger drones such as the Orion and the Turkish Bayraktar TB2 to conduct direct attacks on a variety of military and civilian targets. However, as the losses mounted, both sides switched to the use of cheap, small drones and loitering munitions; while Russia switched to Iranian drones such as the Shahed-131 and 136 for direct attacks,<sup>13</sup> Ukraine was more proactive in secretly manufacturing its own range of long-range kamikaze drones such as the Bober and the UJ-22 to attack targets and cities deep within Russia.<sup>14</sup> Ukraine also developed the Sea Baby, a sea drone with a 450-kg weapon payload, to complement cruise missiles that have been used in several attacks on Russian warships and naval assets in the Black Sea since April 2022.<sup>15</sup>



Russia has fallen back on Iran to sustain its supply of drones in the face of a dramatic slowdown in its own drone production owing to import sanctions on components; for its part, Ukraine is accelerating its own indigenous drone programme. Thus, the use of drones is only likely to increase in the winter, even as ground operations slow down.

### **Lessons for India**

The protracted conflict in Ukraine offers three lessons for India in the air-power domain. First, there is an urgent need to review existing means and methods of gaining control of the air in limited time and space conditions in a short, high-intensity limited conflict as well as in a longer, protracted conflict. It is imperative to benchmark this strategy against a robust and effective air-denial strategy,<sup>16</sup> as practised by Ukraine and Russia. Second, there is a need for a well-sequenced and integrated air campaign plan that is in sync with the ground and maritime plan and places emphasis on maintaining the existing doctrinal focus on the SEAD, particularly against an adversary that is more interested in denying rather than controlling the airspace.

Finally, as drone warfare and cruise missiles have acted as force multipliers and critical enablers, there is a need for investment in these areas to bolster India's capabilities in the face of rapid strides made by China and Pakistan. However, these developments must be made to enhance India's capabilities rather than replace existing ones. Of greater importance is the need to rapidly develop counter-drone capabilities that would be essential in responding to large-scale surprise attacks and retain effective second-strike capabilities.

Policymakers and strategists need to refrain from cloning and superimposing tactical, operational, and technological templates from the Ukraine conflict in the northern, western, and maritime theatres of operations in India. Instead, a nuanced and contextual approach would yield the best dividends and result in calibrated changes to existing strategy, doctrine, and tactics, techniques, and procedures (TTPs), which could lead to better operational outcomes in future conflict scenarios.

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## II

# Geography, Technology, and Circumstance in the Use of Naval Power

Abhijit Singh

**T**he conflict in Ukraine is largely perceived as a land war. Naval aspects of the conflict seem to receive little attention, although they are vital in a broader strategic context.

Indeed, in three crucial areas, naval capability has made a significant contribution to the outcome of the war. First, since the beginning of the conflict, the Russian navy has sought to establish a long-term blockade against Ukraine, with a focus on cutting off Ukraine's key grain-exporting port of Odessa.<sup>1</sup> At the onset of hostilities, the Russian navy deployed a sizable contingent of missile-armed warships and submarines to interdict Ukrainian shipping in the Black Sea. Both Russia and Ukraine deployed naval mines along Ukraine's southern coast with the intention of targeting the other's military forces, which impeded the movement of both warships and merchant shipping.<sup>2</sup>

Second, the Russian navy assisted Russian ground forces with air defence and long-range precision attacks on Ukrainian land targets.<sup>3</sup> After the initial months of the conflict, as Russian troops started shifting their focus towards eastern Ukraine, there was an increased need to create an air-defence system in order to safeguard Russian troops' ammunition depots and logistics facilities against potential Ukrainian airstrikes.<sup>4</sup> Following arduous ground campaigns, the Russian army experienced a scarcity of precision ordnance. It was unwilling to launch strikes from within Ukraine's territory, as Ukrainian forces had acquired the capability to track and target Russian launchers. Russia's missile-armed submarines and warships provided the Russian army with additional strike capacity.<sup>5</sup> Notably, while Russian forces seized

Snake Island—a small island that marks the limits of Ukraine’s exclusive economic zone—and neutralised Ukraine’s meagre naval forces in the initial days of the war, Russia’s amphibious group tasked with holding Ukrainian forces around Odessa and conducting limited amphibious landings in the Azov Sea to support the Russian land campaign did not deploy.<sup>6</sup>

Ukraine, too, has used its limited naval capabilities to disrupt Russia’s aggressive moves in the Black Sea. With Russian land forces keen on gaining crucial strategic depth in the south of Ukraine, where the rail network is sparse and the movement of long-range missiles and ammunition is difficult, Ukraine’s principal motivation has been to thwart Russia’s naval advance that could assist the Russian land campaign in southern Ukraine. The Ukrainian military has achieved notable success in this task. Since a Ukrainian strike on the Crimean city of Sevastopol in September 2023, the Russian navy has been on the defensive. Coming over a year after the strike on the Russian flagship Moskva, the attack on Russia’s Black Sea fleet headquarters in Sevastopol sent shockwaves through Russia’s political and military establishment. Days after the attack, the Russian fleet was relocated to the eastern Black Sea port of Novorossiysk.

From an operations perspective, the Ukraine-Russia war in the Black Sea offers important pointers about the static and dynamic aspects of a naval

war. The first is the reaffirmation that geography, technology, and circumstance have a decisive effect on the outcome of naval operations. The Russia-Ukraine naval war could have turned out differently had there been more than one narrow waterway (i.e., the Bosphorus Strait) connecting the Black Sea to the wider Atlantic. Russia would certainly have been able to better defend Crimea, the focal point of Ukraine’s attacks, from the sea. Likewise, Russia would probably have prevailed in the Black Sea if Ukraine did not have access to Western arms and equipment.

No less crucial is the role of circumstance. Moscow might have been able to shut down all Ukrainian ports if Turkey, which controls access to the Black Sea, had not closed off the Dardanelles and Bosphorus straits for warships.<sup>7</sup> The peculiar geography of the theatre of war, the availability of superior technology on one side (i.e., Ukraine), and the contingent circumstances of the war seem to have made the crucial difference.

It is instructive that the Russian blockade of the Black Sea turned out to be less successful than Moscow had anticipated. The purpose of the blockade was to sever Ukraine’s grain exports and stifle the nation’s economy. Russia, at the insistence of Turkey and the United Nations, briefly entered the Black Sea Grain Initiative, allowing for the safe passage of Ukrainian grain exports and fertilisers.<sup>8</sup>

However, Moscow withdrew from the initiative in July 2023 in an attempt to gain an advantage in the battle. The Russian government orchestrated a sequence of missile and drone strikes on Odessa, Ukraine's main port, causing damage to its infrastructure and facilities.<sup>9</sup> In response, Ukraine announced a humanitarian corridor hugging the western Black Sea coast of Romania and Bulgaria for ships that have been stranded in Ukraine's ports.<sup>10</sup>

The move tested Moscow, which found itself short of naval assets to enforce its embargo. Meanwhile, as Ukrainian forces intensified their own attacks against Russia's Black Sea fleet, Russia found itself increasingly constrained in sending reinforcements into the theatre of conflict. This illustrates the limited utility of a naval blockade as an instrument of war. While it remains a legitimate and effective tactic in non-war situations, a blockade is increasingly unviable in a war in congested geographies and against opponents unwilling to be deterred by show of force.<sup>11</sup>

Further, drone warfare is poised to play a crucial role in future maritime combat. The sinking of the Moskva underscores the importance of drones in a naval war. This was not the only instance of the use of unmanned platforms during the war; in an aerial and naval unmanned attack on Sevastopol on 29 October 2022, Ukrainian unmanned surface vehicles (USVs) targeted Russian warships, including the frigate Makarov, a landing vessel, and a minesweeper.<sup>12</sup> Some analysts consider this attack to mark a critical moment in naval strategy development, with small USVs demonstrating their

utility against stationary units. However, it remains to be seen if USVs will be a weapon of choice in the future. In order for this to happen, armed forces would need to develop suitable doctrines for their deployment. What is clear, however, is that modern USVs are more sophisticated than the uncrewed crafts presently in use in many navies.

However, naval planners need to adopt a more holistic view. Remotely controlled vehicles, while useful in tactical scenarios, are not developed enough to achieve victory in contemporary wars.<sup>13</sup> The effects of drones vary with their mode of operation.<sup>14</sup> Capability-producing airpower drones are used in different ways than single-use munition platforms and produce variable effects. Neither asset is standalone and must be used in tandem with ship-borne weapons and systems. It is worth examining why long-range loitering munitions, despite their potential, have an uneven success rate.<sup>15</sup>

The conflict in the Black Sea also serves to highlight the crucial function that shore-based missiles play in a naval conflict. The attack on the Russian-occupied port of Berdyansk in March 2022 offers an instructive example, wherein Ukraine reportedly used Tochka tactical ballistic missiles to sink the Russian landing ship Saratov and damage



two other warships.<sup>16</sup> Shore-based missiles were also involved in the attack on the Moskva in April 2022. Reportedly, two Neptune anti-ship missiles fired by Ukrainian forces snuck past the Moskva's defences, with the ship's main fire-control radar distracted by a Ukrainian TB2 drone operating in the vicinity.<sup>17</sup> Shore-based missiles were also used in the attack on Sevastopol in September 2023.<sup>18</sup>

The use of anti-ship cruise missiles (ASCMs) has witnessed an increase worldwide. Estimates suggest that ASCMs are readily available in the global arms market, and China has amassed a potent arsenal.<sup>19</sup> Their use is likely to grow, particularly since many of the conflicts in the Indo-Pacific region stem from sovereignty disputes, such as in the South China Sea and the Sea of Japan, and involve territorial incursions by warships and coast-guard vessels.

An analysis of the Russia-Ukraine war suggests that weaker powers use their limited naval capabilities in innovative ways to deter their stronger opponents' attritional approaches. One way to do this is by targeting the adversary's ammunition depots and logistics sites. While both sides in this conflict have resorted to this tactic,

Ukraine went a step further and attacked the Russian military headquarters in Crimea. Thus, Kyiv leveraged the technology and equipment offered by its partners to inflict serious damage on Russian ships in the Black Sea. This constitutes the next lesson—that the only way to achieve success against a stronger adversary in a naval campaign is by adopting an innovative approach that leverages partner strengths.

While the foregoing may not appear to be relevant in an India-Pakistan or India-China context, especially since naval contests in Asia differ from those in the Black Sea, one aspect remains constant: during crises, beleaguered parties tend to think unconventionally whereas stronger ones keep to their tried and tested methods. Weaker powers also tend to adopt more dynamic approaches in battle. Therefore, the most important lesson for naval leaders is that success in contemporary battles is dependent on one side's ability to prepare and execute a nonlinear campaign; the side that develops the best strategy for the situation and makes the best use of available tools wins.

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# The Continued Effectiveness of Armour in Warfare

B. S. Dhanoa

**T**anks have an indispensable role in the twenty-first century battlefield, regardless of the criticism that they have faced since the beginning of this century. The primary role of the tank has remained unchanged since the Second World War: On the offensive, tanks provide mobile, protected lethality that facilitates ground-force manoeuvres; on the defensive, tanks are the most effective weapon against another tank: your gun against the enemy's in a gunfight.<sup>1</sup>

The ongoing Russia–Ukraine War has witnessed the extensive use of tanks in various forms, making them a symbol of land power capabilities and a focal point in the information war between the two sides. It has become a distinctive visual image of claimed tactical victories and defeats for both. Both adversaries continue to assess each other,

rediscovering the doctrine of employing tanks as part of combined arms forces. This situation presents a rare opportunity to study the use of modern tanks by large armies in conventional conflicts over diverse terrains and different operational scenarios, such as offensive, defensive, and urban. Therefore, it is crucial to analyse all available information from open sources to draw relevant lessons for the Indian Army, which continues to hold an inventory of tanks very similar to those of the two warring nations.

## Russia

The Russian use of armour has evolved with time. In 2022, significant losses were incurred due to a lack of understanding of combined arms manoeuvre, inadequate fire support, and logistical challenges to keep pace with overambitious thrusts

in the initial phases of the war. These setbacks prompted Russian commanders to reassess their overreliance on heavy but vulnerable tank formations to provide a knockout blow. The tanks, therefore, proved susceptible in combat. Instead, tanks are now primarily utilised for breakthrough attempts under favourable conditions such as at Vuldehar in late January–early February 2023, led by a Russian naval infantry brigade.<sup>2</sup> However, the heavy losses suffered in both tanks and infantry have prompted caution in the use of such tactics under current conditions.<sup>3</sup>

Tanks are now used in three primary ways. As described by Watling and Reynolds in their article: “First, they are used to supplement artillery capabilities through indirect engagements. Though not as efficient as artillery, they nevertheless fill in the gap when artillery guns become displaced or suppressed. Second, tanks are used as highly accurate fire support assets able to stand off at two km and utilise their enhanced optics to identify and knock out firing positions. A third use of armour is in raiding. Russians often conduct gun raids with tanks when they detect Ukrainian troop rotations.”<sup>4</sup>

Russian armour has also undergone modifications to reduce the effectiveness of anti-tank guided missiles (ATGMs). These modifications include using anti-thermal materials to reduce the heat signature detected by certain types of ATGMs. Additionally, Russian tanks take advantage of ‘thermal crossover’ during dusk and dawn operations when the ambient temperature and that of the tank are almost similar, making it hard for ATGM thermal imaging (TI) sights to detect them.<sup>5</sup> These changes have been specifically brought about based on experience to counter the advantage of Ukrainian ATGM teams with advanced TI sights, limiting their operational freedom by Russian tank crews.

In urban combat, the Russians have been cautious in deploying armour, using tanks primarily to provide fire support to infantry. Their main tasks include enemy fire suppression and creating rapid breaches in buildings to outflank the enemy. The Russians prefer to use older tanks like the T-55 and T-62 as assault guns to avoid casualties of their modern tanks.<sup>6</sup> Based on extensive interviews with Ukrainian soldiers who have first-hand experience with the Russian armour, Watling and Reynolds report that tank-on-tank engagements have become relatively rare. However, when these

engagements do occur, they are usually within 1,000 metres. Russian explosive reactive armour has proven highly effective in preventing most anti-tank systems from penetrating the tank's armour with a single hit.<sup>7</sup>

## Ukraine

During Russia's invasion of Ukraine in February 2022, the Armed Forces of Ukraine (AFU) fielded about 900 tanks organised into 30 tank battalions in various field formations. The Armed Forces of the Russian Federation (AFRF) and their proxies in Donbas, in contrast, had some 3,200 main battle tanks (MBTs) available with the invasion force.<sup>8</sup> The AFU personnel, with years of experience in the Donbas region where low-attributional war was common, had modified their approach to armour usage. Instead of employing tanks in the direct fire zone, they adopted a philosophy of using them as indirect fire platforms.<sup>9</sup> "The use of modern technologies, in the form of graphic and calculation complexes, developed in Ukraine with the function of automated transmission of information to other tanks participating in the combat mission, made it possible to achieve high accuracy at distances of up to 10 km and reduced the time for calculating fire corrections to a few seconds. This technique blurs the line between tanks and artillery."<sup>10</sup> In Ukraine, tanks were primarily used as mobile reserves, supporting formations in the battles, and when possible, to aid in counterattacks under suitable conditions.<sup>11</sup>

While Ukraine has highlighted the heroic deeds of its ATGM crews against inept Russian armour and has flooded social media with footage of Russian tanks and other armoured vehicles being destroyed by drones adapted to carry anti-tank munitions, it also recognises the importance of having armoured vehicles for offensive operations. Ukraine has sought and received modern MBTs from NATO, although in fewer numbers than that desired by AFU. In all, Ukraine will receive more than 800 tanks from the West, including Leopard 2, Challenger 2, and Abrams M1.<sup>12</sup> The Ukrainians have faced unfortunate losses of NATO-provided tanks to Russian strikes in their attempts at regaining territory lost to Russia in Donbas, particularly in the battles for Novodarivka and Rivnopil, two villages straddling the border between Donetsk and Zaporizhzhia oblasts. Although armoured fighting vehicle (AFV) losses have been high when attempting to break through minefields up to 500 metres deep, Ukrainian troops acknowledged that Western-provided platforms were vastly superior to their Soviet-era protected mobility platforms for one critical reason: crew survivability.<sup>13</sup>



## Lessons from the Conflict

Rob Lee, a former US Marine infantry officer doing research on Russian defence policy at King's College London, shares his perspective on armour: "While the Russian military would have been better served in Ukraine by having more infantry and fewer tanks, tanks will continue to be important systems in ground warfare. They remain a key ground component of combined-arms warfare, without which other arms are more vulnerable. Infantry are vulnerable when attempting to seize defensive positions, meaning tanks still play a critical role during offensive operations. Anti-tank guided missiles certainly cannot replace the tank's role in supporting manoeuvre."<sup>14</sup>

Without tanks, a military engaged in large-scale ground war would have to rely on armoured personnel carriers and infantry fighting vehicles, resulting in heavier casualties. Sam Cranny Evans, a former researcher at RUSI, emphasises the need to carefully consider the lessons learnt and ensure that 'new' lessons are not simply repetitions of old ones.

Perhaps taking a more thoughtful approach would involve examining the nature of combat in Ukraine in comparison with previous other conflicts. This analysis would help establish a set of combat principles that militaries can use to shape

their doctrine and AFV requirements.<sup>15</sup> Evans further argues that it is unclear whether the war in Ukraine has revealed any fundamentally new lessons for AFVs in the realm of armoured warfare.<sup>16</sup> However, it is evident that new technologies pose a threat to traditional land power, including the development of advanced ATGMs, unmanned aerial systems (UAS) equipped with a plethora of detection and kinetic anti-tank munitions, and electronic warfare suites that render a tank's own electronic system susceptible to attacks. Both sides have successfully implemented countermeasures against these threats.

Despite the challenges, tanks continue to symbolise national will and serve as a deterrent. Their effectiveness in combined arms warfare, based on the key tenets of mobility, firepower, and protection remains unquestionable. The ongoing Russia–Ukraine war continues to generate valuable insights for military observers, prompting conventional armies like India's to consider how to optimise the tank's effectiveness in future conflicts.

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## IV

# A Litmus Test for the Future of Artillery

Amrita Jash

While the twenty-first century is touted as the age of information war, the Russia–Ukraine war has resurfaced the idea of conventional fighting using firepower. Historically, artillery has been known to be the ‘king of battle,’ but the advent of aeroplanes and airpower revolutionised military affairs, foregrounding precision strikes with high explosives. For instance, since 1945, “flying artillery” replaced the big guns as the favoured source of fire, especially in advanced Western-style militaries such as those of the United States (US), the NATO nations, and Israel.<sup>1</sup> Consequently, in wars such as the Vietnam War and Operation Desert Storm, airpower was pivotal in carrying out precision strikes.

However, with the Russia–Ukraine war, artillery has emerged as the war’s defining feature rather than airpower, with the two sides engaging in an artillery duel. While artillery has been the centrepiece of Russia’s offensive in Ukraine, given the guns and shells that are supplied by the West, artillery has also been central to Ukraine’s counter-offensive. According to Davis Ellison, “[r]ear-area strikes have been some of the most decisive actions undertaken by the Ukrainians so far, to include during this current offensive.”<sup>2</sup>

The European Commission reports that Russia shoots between 40,000 and 50,000 artillery shells every day, while Ukrainian troops use between 5,000 and 6,000. The Estonian government’s estimates range between 20,000 and 60,000 Russian shells and 2,000 to 7,000 rounds from

the Ukrainian artillery, on an average each day. These numbers translate to between 600,000 and 1.8 million Russian shells fired monthly, whereas Ukrainian artillery fires between 60,000 and 210,000 shells in the same period.<sup>3</sup> Therefore, the Russia–Ukraine war has become an important litmus test in assessing the future of artillery.

On the use of artillery in the Russia–Ukraine war, two key aspects have emerged. First is the importance of range. In the words of land-warfare analyst Nick Reynolds, “Range has proven very important as a factor in force projection as much as the ability to strike the enemy deep.”<sup>4</sup> For instance, the US-supplied M142 High Mobility Artillery

**Table 1. Key Artillery Weapons Used by Russia and Ukraine**

Type of Equipment	Russia	Ukraine
Long-Range Rockets	<ul style="list-style-type: none"> <li>BM 30 Smerch <i>Range: 70 Km</i></li> <li>M270 Multiple Launch Rocket System <i>Range: 80 km</i></li> </ul>	M142 HIMARS <i>Range: 80 Km</i>
Howitzers	<ul style="list-style-type: none"> <li>2A36 Giantsint B-howitzer <i>Range: 40 Km</i></li> <li>D-30 howitzer <i>Range: 22 Km</i></li> </ul>	M777 Howitzer <i>Range: 40 Km</i>
Anti-tank Weapons	9M133 Kornet (called AT-14 Spriggan by NATO)	Nlaw Anti-tank Weapon <i>Range: 20-800 m</i>

Source: Author’s own, using various open sources.

Rocket System (HIMARS), which can shoot GPS-guided projectiles out to 50 miles, have allowed Ukraine to carry out devastating strikes against Russia. The second aspect is that of mobility, which has proved vital for survivability.

Given the heavy dependency on artillery fire, the challenge that both sides face is that of artillery shortages and escalating casualties. Various reports such as from the US intelligence now estimate that Ukraine has superiority over Russia in tube artillery, while Russia leads in rocket launchers. Russia, which once fired as many as 50,000 artillery shells in a single day, is now firing only a little over one-tenth of that number, and throughout many of the sectors along the 1,500-mile front, it is only utilising artillery for token attacks.<sup>5</sup> Similarly, due to the shortfall in foreign assistance, Ukrainian soldiers have reduced some of their combat activities and are facing a scarcity of artillery rounds. So far, the US and allies have sent Kyiv more than 2 million artillery shells and have also increased production to replenish stocks.<sup>6</sup>

## Table 2. US Artillery Assistance to Ukraine\*

198 155mm Howitzers and ammunition
72 105mm Howitzers and ammunition
47 120mm mortar systems
10 82mm mortar systems
112 81mm mortar systems
58 60mm mortar systems
203mm, 152mm, 130mm, 122mm
39 HIMAR systems
60,000 122mm Grad rockets
Precision-guided rockets
Ground-Launched Small Diameter Bomb launchers and ammunition

*\*as of 8 December 2023*

*Source: Adapted from Masters and Merrow.<sup>7</sup>*

For both Moscow and Kyiv, the challenge remains in meeting the war's artillery demands, which has led to a stalemate. The Russia–Ukraine war is a crucial test case for other countries to draw lessons from.



Looking at the demonstration of artillery fire in the ongoing Russia–Ukraine war, two lessons are available to the Indian Army. First, that firepower can be a “battle-winning factor”, and second, that the time between acquiring the target to shooting has drastically reduced: where it once took five to 10 minutes, it now takes only minute or two.<sup>8</sup>

As per media reports, top officials have emphasised maintaining robust transparency in the battlefield and the necessity for the Indian Army to have a judicious mix of rockets and guns in the artillery inventory and to acquire more precision-targeting weapon systems and niche technologies.<sup>9</sup> The other significant takeaway has been to ensure adequate measures are taken for “force preservation”, as the lesson learnt here is that India should be prepared for a similarly prolonged war. This, therefore, calls for more quantities of self-propelled guns, mounted guns systems, or towed guns with auxiliary power units with a shoot-and-scoot capability.<sup>10</sup>

Foremost, however, is the need to overhaul the Indian Artillery. Drawing lessons from the war, the Indian Army has been revising and upgrading the profile of its artillery unit, with a focus on combining mobility with increased long-range capability. The army expects to achieve its target of converting the entire artillery to medium 155mm gun systems by 2042. As a source remarked:

“The Regiment of Artillery has done a detailed study along with the Operations Branch. In the revised Artillery profile, Army is going for more self-propelled and mounted gun systems”; the “mediumisation with indigenous guns is likely to be completed by the year 2042.”<sup>11</sup>

What is significant to note is that there is an acknowledgement that firepower alone has the potential to tilt the scales in a war, and thus, manoeuvrability must be complemented by superior firepower. The Indian Army is now aiming for around 300 guns.<sup>12</sup> Currently, there are five K9-Vajra and seven M777 Ultra Lightweight Howitzers (ULH) regiments in the army. Additionally, the Ministry of Defence has floated two requests for proposals worth ₹300 crore each for more than 600 guns of 155mm/52 calibre;<sup>13</sup> this includes the Advanced Towed Artillery Gun Systems (ATAGS) and the Mounted Gun System (MGS). The Indian Army has also placed orders for 114 Dhanush guns, which are indigenously upgraded based on the Bofors guns, and 300 Sharang guns, which are to be upgraded from 130mm to 155mm.<sup>14</sup>

Emphasis is also being placed on developing more lethal and precision ammunition for its ULH gun systems, for the Pinaka rockets, and others.<sup>15</sup> Apart from upgrading the guns, there is a clear focus on indigenisation of munitions, where private companies, such as Tata Advanced Systems Ltd (TASL) and Bharat Forge are playing key roles. In this process of overhauling the Artillery Regiment, the Indian Army has adopted a five-point plan.

The Russia–Ukraine war has provided a learning experience for India in reviving its own artillery power for military preparedness. More significantly, the situation has provided a push towards indigenisation, thereby providing a boost to India’s defence industrial base.

**Table 2. Five-Point Plan to Revamp the Indian Artillery**

Aim	Agenda
Mediumisation of Guns (to 155 mms)	Adoption of technologically advanced platforms for artillery pieces
Development of Rockets and Missile Regiments	These regiments will feature extended ranges and heightened precision, aligning with the modern battlefield’s demands.
Modernisation of Munitions	The emphasis is on munitions with enhanced ranges and accuracy.
Reorganisation of Surveillance and Target Acquisition (SATA) Units	These units will undergo restructuring to optimise surveillance, data management, coordination, and targeting capabilities.
Development of Sensor-Shooter Networks	Establishing efficient sensor-shooter networks and processes is crucial for modern artillery operations.

Source: Author’s own, using Siddiqui.<sup>16</sup>

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V

# The Current Utility of Space Power

Rajeswari Pillai Rajagopalan

**T**he military potential of outer space has been recognised and utilised since the beginning of the space age. Over the last two decades, this use has expanded enormously due to various reasons. First, space technology has improved in many areas, including communications, earth observation, and navigation. Second, the technology has become cheaper, allowing for wider usage. The technology has also spread, allowing it to be employed by both private corporations and states. It is not surprising, therefore, that militaries around the world have been increasingly using space for a variety of purposes. Russia's invasion of Ukraine and the continuing war has demonstrated the growing utility of space even in conventional military operations.

One of the key aspects of the military use of space is surveillance. As soon as the United States (US) and the Soviet Union developed satellites, they began deploying them for surveillance; both nuclear powers were afraid of a surprise attack by the other side, and space-based surveillance was an effective means of keeping a watch on each other. This is particularly true for nuclear missile launches, since space-based infrared camera-equipped satellites could identify the heat plumes of large rockets. These satellites were integrated into the strategic early warning systems of both countries. These surveillance satellites also played an important role in arms control, which recognised the role of 'national technical means' for monitoring each other.

Surveillance satellites have become increasingly sophisticated since those early days; current satellites are able to detect even small objects because of improvements in camera resolutions. This allows the satellites to spot even conventional military concentrations of forces. This feature has been useful in the Ukraine war and allowed the US and allied satellites to detect and inform Ukraine about the launch of the Russian invasion. The US and its allies continue to provide Ukraine information about Russian force deployments, allowing it to plan both offensive and defensive actions.

Media reports say Ukraine has now acquired a synthetic aperture radar (SAR) from the Finnish company ICEYE, which is funded by volunteers and has reportedly been highly effective.<sup>1</sup> This illustrates the spread of such satellite technology as well as its affordability. Private commercial satellites are increasingly being used by news agencies, non-government organisations, and even private individuals for various purposes, including for monitoring military operations.

In addition to military uses, these satellites are effective in monitoring human rights abuses, such as in Bucha, where satellite surveillance demonstrated the occurrence of massacres after Russian forces moved in.<sup>2</sup> In the case of Ukraine, Kyiv's partners, rather than Kyiv itself, have

access to satellite surveillance. Russia has long had such capabilities, and this is clearly aiding its operations. It must be noted, however, that satellite surveillance only provides information about the disposition of forces and can say little about the capacity or effectiveness of those forces. Thus, despite its enormous capacity for satellite surveillance, Russia's initial invasion failed because it did not account for the grit and determination of Ukrainian defenders nor could it compensate for the poor planning and overconfidence of Russian forces. This goes both ways, as demonstrated by a failed Ukrainian counteroffensive in the summer of 2023.

Targeting is one area in which surveillance has been effective in the Ukraine war. Both Russia and Ukraine appear to have used space-based surveillance to find and target critical assets on the other side. While the wide use of drones in the war makes it difficult to say how much of this surveillance was accomplished through space-based assets, it is likely that space-based surveillance played some role in deep penetration attacks, such as Russia's repeated long-range strikes on Ukraine as well as Ukrainian strikes behind forward battle areas, such as in Crimea.

Navigation is another area in which space-based assets have proved to be extremely useful. The US developed the Global Positioning System (GPS) for military purposes, though its use has now spread to civilian domains. However, military GPS is considered to be far more accurate.

A number of countries have now developed their own comparable systems, such as the Russian Glonass, the Chinese Beidou, and the Indian NAVIC. These are used to guide not only military forces, but also weapons to their targets. These systems have also enabled “dumb bombs” or unguided munitions released from aircraft to be fitted with GPS-enabled guidance systems that significantly increase their accuracy. The potency of these GPS-enabled systems was illustrated in several US combat operations in the post-Cold War period, especially in Iraq. Ukraine has used them extensively in a variety of systems, including ground-launched rockets like Himars. These rockets and bombs wreaked havoc on Russian forces, at least when they were first introduced.

Though GPS-guidance is passive—i.e., they only receive, and do not emit signals—incoming GPS signals could be jammed, which has proved to be a vulnerability. Russia’s strong electronic warfare capabilities have adapted to Ukraine’s use of such GPS-enabled systems. Russia now uses GPS jamming to prevent GPS signals from reaching the

rockets, thus throwing them off target. Russia also appears to be using GPS jamming to prevent drone attacks by Ukraine, including on Moscow. However, GPS jammers are not available everywhere, and Ukraine appears to have found other ways to use its GPS-enabled systems to ensure their effectiveness. While a lot of the cat-and-mouse tactics between electronic systems and counter-systems are likely to be unavailable for analysis for the foreseeable future, it is clear that GPS and other navigation systems have had a crucial impact on the Ukraine war and in the wars of the future.

Another area where space-based assets have had an impact is in communication systems. Space-based communication was a crucial improvement over terrestrial, radio-based communication systems because it was less limited by issues such as range and terrain. Satellite-based communications have also grown in sophistication since the 1970s and 1980s. Satellite-based communication systems allow military leaders to maintain command and communication with forces deployed far from headquarters. They are also useful for maintaining communication between forces. One of the most innovative developments has been the Starlink system, which uses a large array of small satellites to provide internet communications. This now includes over 5,000 small satellites in the low Earth orbit.

One advantage of the Starlink system is that it depends on hundreds of small satellites, rather than on one or two large satellites which can be easily jammed. In its Ukraine operations, Russia was able to successfully attack and disable Ukraine's regular satellite-based communication networks; Ukraine quickly moved to the Starlink system. However, because Starlink is a private company, its operations have been idiosyncratic; while Starlink helped Ukraine in the early stages of the war, it refrained from assisting Ukraine in attacking Russian targets behind the frontlines, including in Crimea. This appears to have constrained Ukrainian operations to some extent.

Nevertheless, this also illustrates some of the changes in space-based technology in modern warfare. The Starlink episode shows both the tremendous advances in space-based communications for military uses as well as the far greater role played by private actors that are not necessarily answerable to states. It is possible that other private companies and governments will

develop their versions of the Starlink system, and private operators such as Amazon and Samsung, and countries such as China and Iran are already planning to follow suit.

There is little doubt that space technology and space-based technologies have had a tremendous impact on the Ukraine war. While they have facilitated some operations, the overall shape of the war continues to be determined by more traditional factors, including relative military power, planning, training, and will power. Space technology can make some difference, but in such military operations, it is unlikely to make the difference between victory and loss.



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## VI

# Battlefield Algorithms: AI and Cyber Warfare in the Russia-Ukraine War

Shimona Mohan

**I**t is well established that data is the new oil,<sup>1</sup> and this comparison is quickly becoming even more pronounced in high-risk applications like conflict-related data-based systems and operations. New and emerging technologies like cyber systems and artificial intelligence (AI) have transformed the conventional battlespace and introduced a completely new component to modern warfare, fuelled in part by the incumbent tech arms race.<sup>2</sup> Big players like the United States (US), China and Russia have raised the stakes herein by investing heavily in the design, development and deployment of strategies and systems to modernise their militaries, and early results of this are only recently being seen.

One of the most prominent of these examples is the Russia-Ukraine war which broke out in

early 2022. While the war has been a hotbed of kinetic warfare and conventional weapons, a closer look at the dynamics of the conflict also shows a propensity from each side to try to gain an upper hand by employing frontier technologies like cyber and AI. In a way, the war is proving to be a testing ground for various battle systems based on these technologies and provides lessons for other countries whether actively involved with either side or mere observers.<sup>3,4</sup> This chapter provides a catalogue of the types of algorithmic systems and operations in use by both Russia and Ukraine, including documented examples of their deployment, and concludes with provisional takeaways.

## Cyber-Physical Attacks and Cyber Warfare

Russia's initial foray into Ukraine came with a supplementary cyber salvo, which was later countered by Ukraine through cyber means as well, thus extending the battlefield into the virtual realm. Russian cyber-attacks ranged in intensity and scope across a number of Ukrainian setups, and targeted mostly civilian cyber architectures such as hospitals<sup>5</sup> and communication systems like mobile network operator Kyivstar.<sup>6</sup> Russian hackers acted in tandem with the military and also conducted synchronous cyber-physical attacks, such as combining a missile attack on Odessa with a cyber-attack on the website of the City Council of Odessa,<sup>7</sup> and a combined cyber and missile strike targeted at a TV tower in Kyiv.<sup>8</sup>

However, while they carried the element of surprise, Russian cyber-attacks were soon matched by their Ukrainian counterparts, which aimed at different sections and functions of the Russian war machine. Ukraine targeted the financial data of Russian military personnel via Russian banks, and hacked Russian television and radio broadcasts to reveal details of Russian military casualties and war crimes to the Russian population that was already divided over the war.<sup>9</sup> Ukrainian hackers also created fake dating profiles to lure Russian soldiers into interacting with them and sharing their location, which revealed Russian military bases that Ukraine then went ahead and attacked.<sup>10</sup>

## Autonomous Weapons and Artificial Intelligence

Russia has been at the forefront of military modernisation using AI in the recent past, and employed a range of (semi) autonomous capabilities in its existing conventional weaponry for the war, for instance in uncrewed aerial vehicles (UAVs), drones, naval systems, geospatial intelligence, and object recognition.<sup>11</sup> While Russia's deployment of AI-based weapons remains expected and limited, Ukraine received external support to upgrade its existing repertoire of systems with novel AI applications. Clearview AI, a facial recognition tech company, provided its software to Ukraine, which was then able to use the database to identify Russian soldiers involved in the war, using their personal identifiers and details, and also to locate missing Ukrainian children by combing through Russian social media.<sup>12</sup>

Notably, Ukraine may also be the first country in the world to have been confirmed to use autonomous drones that can target and kill without a human operator in the loop.<sup>13</sup> The Ukrainian military in October 2023 greenlit the use of the Saker Scout drones, which can autonomously find, identify and attack 64 different types of Russian 'military objects,' even in communications-denied

environments.<sup>14</sup> The use of this weapon system has massive implications not just for the Russia-Ukraine war, but also modern warfare writ large, given that their use is under heated discussion in intergovernmental regulatory forums around lethal autonomous weapons systems (LAWS).

### **Disinformation and Psy-Ops at Scale**

A more understated application of AI in the war has been through the use of deepfakes, i.e. digital media that has been created or altered using AI in such a way that it superimposes the visual and/or auditory likeness of one person or thing over another.<sup>15</sup> Around the beginning of the war, a video showing the likeness of Ukrainian President Volodymyr Zelensky surfaced on social media, showing him surrendering to Russia and calling on Ukrainian citizens to lay down arms and return to their homes.<sup>16</sup> The video was later uploaded to a Ukrainian news agency's website by presumably Russian hackers,<sup>17</sup> but was quickly confirmed by Zelensky to be a deepfake.<sup>18</sup>

Similar deepfake videos emerged from the Ukrainian side as well, with one portraying Russian President Vladimir Putin announcing peace<sup>19</sup> and shared on Twitter (now X) with a caption written in Russian asking their soldiers to leave while they were still alive.<sup>20</sup> While these were clear

attempts at spreading disinformation, deepfakes have also been used in this context as a means of psychological operations, or psy-ops, at scale. For instance, Ukrainian officials had shared a deepfake video of Paris being attacked by Russian airstrikes,<sup>21</sup> captioning it with the idea that Ukraine is the first line of defence against Russian aggression, and that the rest of Europe will also fall if Ukrainian resistance is not supported by Europe.<sup>22</sup>

### **Key Takeaways**

While it is still early to draw conclusive takeaways around the use of emerging tech on the battlefield given that the war is still in progress, it is possible to make a note of interim lessons at this juncture. Both countries have showcased that while kinetic warfare continues to be the preferred *modus operandi*, new tech provides several strategic advantages to its bearers—such as giving better access to information for planning and operationalising attacks; diverging the modes and arenas of war to distract the adversary; and spreading (dis)information that can alter public discourse and support for the war.

Given that Russia has largely been self-sufficient in terms of its military technology, it seems like it is clearly valuable for countries to invest into their defence tech infrastructures given the advantages therein, both in number and intensity, regardless

of the scale of their (potential) conflicts. However, if this is not feasible for socio-political or economic reasons, it should be a priority for countries to ensure that their strategic geopolitical allies are formidable tech powers—for instance in this war, Ukraine received much support from its more tech-savvy partners like the US and private tech companies.

This also brings forth another observation, which is the increasing role of largely civilian organisations like big tech in conflict situations and the deepening interplay of civil-military partnerships around dual-use technologies like AI.<sup>23</sup> This is an offshoot of the larger idea that the flow of new technology, which used to trickle down from high-calibre military innovation to low-risk civilian use (such as the creation of the internet

by the US Defense Advanced Research Projects Agency<sup>24</sup>), has been reversed.<sup>25</sup> It is now primarily novel civilian technology that flows into military innovation ecosystems, where its dual-use potential is explored and then enhanced and/or customised as per its use case for defence and security.

The insights from the tech deployment in the Russia-Ukraine war facilitate a broader understanding of warfare in the 21<sup>st</sup> century and beyond, and keeping an eye on its progression as well as conclusion will ensure a continuous appraisal of the same. ORF

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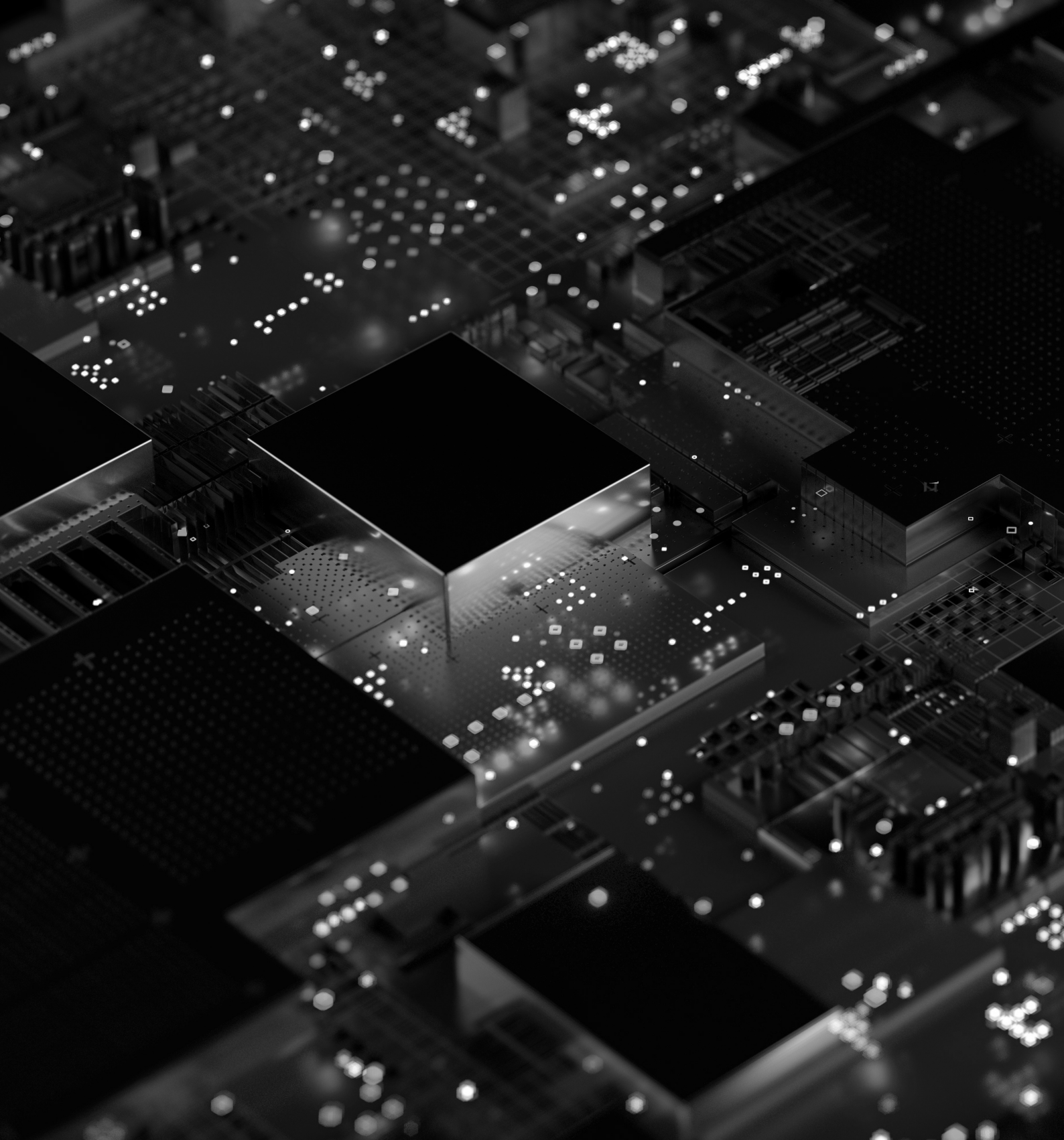
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