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Meatgrinder: Russian Tactics in the Second Year of Its Invasion of Ukraine

Jack Watling and Nick Reynolds



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Executive Summary

THE SCALE OF Russian losses in 2022, combined with the Armed Forces of the Russian Federation confronting NATO systems they had not previously contended with, has caused a significant deviation in Russian operations from the country's doctrine. This report seeks to outline how Russian forces have adapted their tactics in the Ukrainian conflict and the challenges this has created for the Ukrainian military that must be overcome. The report examines Russian military adaptation by combat function.

Russian infantry tactics have shifted from trying to deploy uniform Battalion Tactical Groups as combined arms units of action to a stratified division by function into line, assault, specialised and disposable troops. These are formed into task-organised groupings. Line infantry are largely used for ground holding and defensive operations. Disposable infantry are used for continuous skirmishing to either identify Ukrainian firing positions, which are then targeted by specialised infantry, or to find weak points in Ukrainian defences to be prioritised for assault. Casualties are very unevenly distributed across these functions. The foremost weakness across Russian infantry units is low morale, which leads to poor unit cohesion and inter-unit cooperation.

Russian engineering has proven to be one of the stronger branches of the Russian military. Russian engineers have been constructing complex obstacles and field fortifications across the front. This includes concrete reinforced trenches and command bunkers, wire-entanglements, hedgehogs, anti-tank ditches, and complex minefields. Russian mine laying is extensive and mixes anti-tank and victim-initiated anti-personnel mines, the latter frequently being laid with multiple initiation mechanisms to complicate breaching. These defences pose a major tactical challenge to Ukrainian offensive operations.

Russian armour is rarely used for attempts at breakthrough. Instead, armour is largely employed in a fire support function to deliver accurate fire against Ukrainian positions. Russia has started to employ thermal camouflage on its vehicles and, using a range of other modifications and tactics, techniques and procedures (TTPs), has significantly reduced the detectability of tanks at stand-off ranges. Furthermore, these measures have reduced the probability of kill of a variety of anti-tank guided missiles (ATGMs) at ranges beyond 1,400 m.

Russian artillery has begun to significantly refine the Reconnaissance Strike Complex following the destruction of its ammunition stockpiles and command and control infrastructure by guided multiple launch rocket systems (GMLRS) in July 2022. This has resulted in much closer integration of multiple UAVs directly supporting commanders authorised to apply fires. Russian artillery has also improved its ability to fire from multiple positions and to fire and move, reducing susceptibility to counterbattery fire. The key system enabling this coordination appears to be the Strelets system. There has been a shift in reliance upon 152-mm howitzers to a much greater emphasis on 120-mm mortars in Russian fires; this reflects munitions and barrel availability. Responsive

Russian fires represent the greatest challenge to Ukrainian offensive operations. Russian artillery is also increasingly relying on loitering munitions for counterbattery fires.

Russian electronic warfare (EW) remains potent, with an approximate distribution of at least one major system covering each 10 km of front. These systems are heavily weighted towards the defeat of UAVs and tend not to try and deconflict their effects. Ukrainian UAV losses remain at approximately 10,000 per month. Russian EW is also apparently achieving real time interception and decryption of Ukrainian Motorola 256-bit encrypted tactical communications systems, which are widely employed by the Armed Forces of Ukraine.

Russian air defences have also seen a significant increase in their effectiveness now that they are set up around known, and fairly static, locations and are properly connected. Although Russia has persistently struggled to respond to emerging threats, over time it has adapted. Russian air defences are now assessed by the Ukrainian military to be intercepting a proportion of GMLRS strikes as Russian point defences are directly connected to superior radar.

Russian aviation remains constrained to delivering stand-off effects, ranging from responsive lofted S-8 salvos against Ukrainian forming-up points, to FAB-500 glide bombs delivered from medium altitude to ranges up to 70 km. The Ukrainian military notes that Russia has a large stockpile of FAB-500s and is systematically upgrading them with glide kits. Although they only have limited accuracy, the size of these munitions poses a serious threat. The Russian Aerospace Forces remain a 'force in being' and a major threat to advancing Ukrainian forces, although they currently lack the capabilities to penetrate Ukrainian air defences.

Following the destruction of Russian command and control infrastructure in July 2022, the Russian military withdrew major headquarters out of range of GMLRS and placed them in hardened structures. They also wired them into the Ukrainian civil telecommunications network and used field cables to branch from this to brigade headquarters further forward. Assigned assets tend to connect to these headquarters via microlink, significantly reducing their signature. At the same time, from the battalion down, Russian forces largely rely on unencrypted analogue military radios, reflecting a shortage of trained signallers at the tactical level.

An overview of Russian adaptation reveals a force that is able to improve and evolve its employment of key systems. There is evidence of a centralised process for identifying shortcomings in employment and the development of mitigations. Nevertheless, much of this adaptation is reactive and is aimed at making up for serious deficiencies in Russian units. The result is a structure that becomes better over time at managing the problems it immediately faces, but also one that struggles to anticipate new threats. The conclusion therefore is that the Russian Armed Forces pose a significant challenge for the Ukrainian military on the defence. Nevertheless, if Ukraine can disrupt Russian defences and impose a dynamic situation on them, Russian units are likely to rapidly lose their coordination. Changes in the air combat environment, for example, have led rapidly to incidents of Russian fratricide.

For Ukraine's international partners, supporting Ukraine in liberating its territories is arguably shifting from an emphasis on key systems, to the need for dedicated training and the assurance that equipment provided to the Ukrainian military can be sustained. Tactics will be critical to the effective disruption of Russian forces and their eventual defeat.

Introduction

BY ANY REASONABLE metric, 2022 was a disaster for the Russian military. After its invasion of Ukraine, a combination of uneven and inadequate training, poor force employment, and insufficient forces for sustained large-scale combat operations collectively caused the loss of many of its most capable troops and much of its modern equipment.¹ The ground forces bore the brunt of these losses, though elements of the navy and aerospace forces suffered substantial attrition. Moreover, as international support for Ukraine has led to many Western weapons systems being employed against Russian troops for the first time, the Armed Forces of the Russian Federation (AFRF) are confronting challenges they have not previously dealt with.

Nevertheless, Moscow's policy has been to continue the war. The ongoing reconstitution of Russian forces, and the pressure from new battlefield factors, have led to significant changes in how the Russian military fights. The study of the AFRF has often been heavily focused on the parsing of Russian doctrine.² The relevance of Russian doctrine to how the AFRF fights, however, is becoming increasingly uneven. For Ukraine's partners to calibrate their ongoing provision of support, it is important that Russia's emerging tactics are properly understood. It is also important that NATO members, recapitalising their forces to ensure the future deterrence of Russia, understand how the threat is evolving. Although the Russian military may change considerably before its forces directly confront NATO, the evolution is worth tracking.

This report describes how Russia is currently carrying out its combat operations in Ukraine. It does not outline in detail which of these tactics are more or less successful, or describe Ukrainian tactics, as these are operationally sensitive. The material contained in this report has been primarily assembled from interviews with and observations of Ukrainian military units in April and May 2023, supported by similar material assembled throughout 2022. This included interviews in April and May 2023 with members of the 1st, 17th, 24th, 25th, 30th, 31st, 51st, 58th, 71st and 112th Brigades of the Armed Forces of Ukraine (AFU) across all officer ranks and some enlisted troops. The interviewees had a wide range of experience throughout the war, including the defence of Kyiv, Chernihiv, Kharkiv, Bakhmut and Avdiivka, and participated in offensive operations in Kherson and Kharkiv. The authors also spoke to several officers responsible for data collection, assessment and dissemination of lessons within the General Staff of the AFU, and with members of the staffs from Ukraine's operational-level commands. The contents of

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1. Stijn Mitzer and Jakub Janovsky in collaboration with Joost Oliemans, Kemal, Dan, and naalsio26, 'Attack On Europe: Documenting Russian Equipment Losses During The 2022 Russian Invasion Of Ukraine', Oryx, 24 February 2022, <<https://www.oryxspioenkop.com/2022/02/attack-on-europe-documenting-equipment.html>>, accessed 13 May 2023.
 2. Lester W Grau and Charles K Bartles, *The Russian Way of War: Force Structure, Tactics and Modernization of the Russian Ground Forces* (Fort Leavenworth, KS: Foreign Military Studies Office, 2016).

these interviews were compared with the observations of a range of Ukraine's international partners and from public source imagery and accounts.

The report divides the descriptions of Russian tactics by combat function, spanning infantry, engineers, artillery, armour, electronic warfare, air defence, aviation, and command and control. It concludes with an overview of the priorities for those wishing to support Ukraine in liberating its territory. This report should not be considered an academic analysis as it was written in Ukraine from field notes and does not engage extensively with wider literature. Nor, given the limitations on what can be publicly discussed, does it fully endeavour to analyse the implications of what is covered as doing so properly would breach the AFU's operational security. Instead, this should be understood as reportage informed by sustained and extensive engagement and debriefing of Ukrainian combat units.

There are ways in which this report – if inappropriately exploited – could be misleading. In the first instance, an analysis that is premised on interviews could easily be a collection of anecdotes, thereby suggesting that isolated examples are reflective of wider trends. To avoid this, this report very rarely cites individual examples but instead outlines points of consistency between multiple accounts from combatants with experience from different sectors. Conversely, however, a report that seeks to describe a general Russian approach risks implying a level of uniformity, coherence and intentionality to tactics that may be very uneven in their application. It is noteworthy that there are regular studies conducted by different technical institutes of the Russian military and their findings are disseminated to combat formations, recommending alterations to the employment of equipment, and structure and application of formations. There is an ongoing process at work in the Russian military to identify lessons. Without unit rotation and collective training, however, it is hard for many of these recommendations to be implemented by troops in contact and the result is differing levels of adoption. At the same time, some tactics are emerging from the bottom up and are being distributed along the front. The reader should bear in mind therefore that the descriptions of how Russia is fighting in this report do not represent the result of a coherent redesign of force structure or combined arms tactics, but rather the adaptation within branches of the Russian military.

Perhaps most importantly, this report is not an operational study and does not seek to predict the likelihood of success in any Ukrainian offensive operations. Public reflections would be utterly inappropriate before any such actions are attempted. Given the roughly 1,200 km of front along which forces are engaged to varying levels of intensity, Russian positions are not uniformly well defended; there are gaps. Equally, not all of that front offers suitable ground for offensive manoeuvre. Just because the Russians have an approach to layered defence does not mean that those defences are well served or equally sophisticated in all sectors. Nevertheless, the tactical challenges outlined in this report are ones that Ukrainian forces will have to contend with to varying degrees in whichever direction they move to reclaim their territory. The authors hope that in outlining these challenges, this report can properly calibrate the expectations of Ukraine's partners and indicate where their support can make the greatest difference in liberating Ukraine's land and preserving the lives of its soldiers.

Infantry

AT THE BEGINNING of the war, the Russian military operated in mechanised Battalion Tactical Groups (BTGs) which were supposed to be combined arms formations comprising mechanised infantry, tanks, artillery and other attached enablers.³ The Russians had insufficient infantry in their BTGs,⁴ while the units lacked cohesion or sufficient staff capacity to properly employ their combined arms elements.⁵ Casualties and the failure of the approach have led the AFRF to revert to relying on four infantry unit types: disposable; line; assault; and specialised. These are used in combination in both attack and defence, in a manner shaped by current operational challenges that is not formally codified in doctrine.⁶ Line, assault and specialised infantry are generated through the normal Russian recruitment and training system. Line infantry are generally based on mechanised units. They differ from assault infantry in that they have not received specific assault training and are therefore mainly used for supporting tasks, improving and occupying defensive positions. Assault infantry have received additional training, closer to what would be expected of NATO light infantry forces, and are considered to be a skilled and valuable asset. As such, they are spared some of the mundanity and back-breaking labour of digging in for defensive operations in order to prevent fatigue and attrition, and to allow them to conduct rehearsals for offensive operations. Russian Airborne Forces (VDV) and naval infantry units are generally, though not universally, assault units in practice, with a cultural expectation that they will have an *esprit de corps*, level of competence and appropriately aggressive mindset. Wagner Group and other Russian private military companies (PMCs) have also been involved in the formation of assault units.⁷ Specialised infantry might be generated from the infantry, VDV, the professional elements of Wagner Group, Spetsnaz or other corps, but have received additional role-specific training and equipment which allow for a particular kind of employment.

Russia's disposable infantry should be considered fundamentally different and are drawn from three principal sources: conscripts from the Luhansk and Donetsk People's Republics (heavily attrited from early rounds of fighting); prisoners drafted by the Wagner Group; and under-trained mobilised Russian civilians. These troops were originally formed into companies of

3. Lester W Grau and Charles K Bartles, 'Getting to Know the Russian Battalion Tactical Group', *RUSI Commentary*, 14 April 2022.

4. Michael Kofman and Rob Lee, 'Not Built for Purpose: The Russian Military's Ill-Fated Force Design', *War on the Rocks*, 2 June 2022.

5. Author interview with Lt Gen Mykhailo Zabrodskyi, Ukraine, August 2022.

6. These four types are not Russian terms of art, but functional descriptions of Russian practice.

7. Author interview with a senior analyst in the Ukrainian intelligence community (Q), Ukraine, August 2022; author interview with the head of the Russia desk at one of Ukraine's intelligence agencies (R), Ukraine, March 2023.

approximately 60 people,⁸ but have since been broken down into platoons of approximately 15.⁹ They are issued with small arms. Ukrainian troops report that they often appear to be under the influence of amphetamines or other narcotic substances, with material recovered from the battlefield indicating that these are commonly taken in liquid form.¹⁰

In the attack, disposable infantry are the first to be employed. Disposable platoons are assigned to those avenues of approach to Ukrainian positions that are deemed to offer some cover and thus could prove viable. Although these have been described colloquially as ‘human wave attacks’,¹¹ they no longer involve a dense concentration of infantry conducting an assault in a single mass. Rather, a disposable fire team of two to five personnel is sent from a forming-up position in the Russian front line and advances to contact. There may be up to five fire teams pushed across an axis at any one time, but normally only one or two teams will be able to work forwards.¹² The team will skirmish with Ukrainian defensive positions on contact, often until killed. Ukrainian troops noted that many continued to advance, even after being wounded. On more than one occasion Ukrainian soldiers report that disposable infantry have been shot from Russian positions when attempting to retreat.¹³ As teams are destroyed by defensive fire, Russian forces will commit successive teams forward by the same line of approach. Ukrainian forces must continuously defend their positions against consecutive waves, expending ammunition, exposing the locations of their defensive positions, and exhausting their personnel.

If these attacks were executed by capable assault troops motivated by factors other than coercion and narcotics, they would be roughly equivalent to historical assault tactics such as the

8. Author interview with a battalion commander in the 71st Brigade (A); author interview with an officer of J7 of the Ukrainian General Staff (B); author interview with a field grade officer in Tactical Group Adam (C), Ukraine, April 2023.

9. *Ibid.*

10. Author interviews with A; author interview with B; author interview with C; author interview with Deputy Commander of Northern Command (D); author interview with members of an assault infantry section (E); author interview with a senior member of the Ukrainian intelligence community (F); author interview with Deputy Battalion Commander in the 1st Armoured Brigade (G), Ukraine, April 2023.

11. Open source descriptions of Russian assault tactics are beginning to emerge, although some details remain incomplete. See Andreas Kluth, ‘Russia’s “Human Wave Attacks” Are Another Step Into Hell’, *Washington Post*, 14 February 2023; Olivia Yanchik, ‘Human Wave Tactics are Demoralizing the Russian Army in Ukraine’, *Atlantic Council*, 8 April 2023; Quentin Sommerville, ‘Bakhmut: Russian Casualties Mount but Tactics Evolve’, *BBC News*, 16 March 2023.

12. Author interviews with A; author interview with B; author interview with C; author interview with D; author interview with E; author interview with G; author interview with a junior officer in 24th Brigade (H); author interview with a battalion commander in 1st Armoured Brigade (I), Ukraine, April 2023.

13. Author interviews with A; and author interview with F. This was noted by several Ukrainian soldiers although the incidents appeared to be sporadic rather than systematic.

‘short attacks’ of the Chinese People’s Volunteer Army in the Korean War.¹⁴ The term ‘human wave attacks’ is certainly misleading for probes by successive small assault teams against enemy defences. However, the way that they are conducted is not conducive to successful assaults nor to the maintenance of momentum. Rather, the continuous conduct of this activity, across all axes, is a form of reconnaissance that allows the Russian forces to do two things. First, they find points of weakness in the Ukrainian defences where these troops make surprising amounts of progress or face very limited fire. These are then prioritised for deliberate assault. Alternatively, where the defence is strong, the revelation of Ukrainian firing positions allows specialised troops to begin targeting them.

Russian specialised troops are deployed as irregular groupings of snipers, artillery spotters and support weapon operators.¹⁵ While Ukrainian forces are suppressing disposable infantry, additional disposable troops are often pushed forwards as working groups to dig fox holes and prepare firing positions closer to Ukrainian defences. These personnel are withdrawn and replaced by specialists who can establish observation and sniping posts or set up heavy weapons. They can then be used to direct accurate fire against Ukrainian firing posts from a range of up to 2 km and inflict attrition.

Conversely, if a weaker point is identified and a deliberate assault is planned, the approach is to move additional disposable troops to dig forward positions for specialised infantry. Rather than seeking to simply attrit the defence, this becomes a base of fire. Furthermore, artillery fire shifts from harassment to barrage, enabling Russian assault infantry to attack – often favouring a flank. Assault infantry tend to advance in company strength with the support of armour and, among better Russian units, utilising a mixture of artillery systems. 152-mm howitzers fire until the assault is 400 m from the target position, after which fire is taken over by 122-mm howitzer or 120-mm mortar fire until the assault closes to its final assault positions. The final advance is covered by infantry mortars and then grenades are used before entering the target position.¹⁶ These troops tend to endeavour to turn the flank of a defensive position. On taking a position, they are often withdrawn and replaced by line infantry and additional disposable troops who set about fortifying the position so that it can be held as a base for further probing actions.

It should be noted that, in the attack, Assault Detachments (‘Штурмовые отряды’) have long held a place in Soviet and Russian military doctrine,¹⁷ and the Russian military has produced

14. Roy E Appleman, *Disaster in Korea: The Chinese Confront MacArthur* (College Station, TX: Texas A&M University Press, 1989), pp. 353–63.

15. Author interviews with A; author interview with B; author interview with C; author interview with D; author interview with Commander 31st Brigade (J), Ukraine, April 2023.

16. Author interviews with a senior analyst in the Ukrainian general staff (K), Ukraine, April 2023.

17. Claude R Sasso, ‘Soviet Night Operations in World War II’, Leavenworth Paper No. 6 (Fort Leavenworth, KS: Combat Studies Institute, US Army Command & General Staff College, 1982), pp. 20, 28; Lester W Grau and Charles K Bartles, *The Russian Way of War: Force Structure, Tactics and Modernization of the Russian Ground Forces* (Fort Leavenworth KS: Foreign Military Studies Office, 2016), p. 140.



A Ukrainian BMP drives through smoke, Ukraine, April 2023. *Courtesy of Jack Watling*

updated manuals detailing how these should be structured and employed. In some ways the guidance provided is reflected in Russian offensive operations. The digging of forward positions in preparation for attacks, the use of artillery, the way that armoured vehicles are used separately for stand-off fire support, the use of specialist enabling teams, and the division of infantry platoons into three-to-five-man fire-teams, are all in evidence, although with great variation from the strict doctrinal task organisation provided. Furthermore, probably because to do so would be politically untenable, the doctrine makes no distinction between the specially trained assault infantry teams that form the backbone of assault detachments and their disposable counterparts. The divergence between doctrine and observed practice likely owes much to the inability of the AFRF to either train according to the doctrine or implement it effectively and consistently.¹⁸

18. For more details, see The Main Directorate of Combat Training of the Armed Forces of the Russian Federation, *Особенности ведения боевых действий в городе (населенном пункте) и лесозащитной полосе в составе штурмового отряда (роты, взвода) [Features of Conducting Combat Operations in a City (Settlement) and a Forest Protection Zone as Part of an Assault Detachment (Company, Platoon)]* (Moscow: Ministry Of Defence, 2022), published online in 'Минобороны России издало методичку по штурмовым действиям по опыту войны против Украины. ДОКУМЕНТ.' ['The Russian Ministry of Defense has published a training manual on assault operations based on the experience of the war against Ukraine. DOCUMENT.'], CENSOR.NET, 12 December 2022, <https://m.censor.net/ru/news/3386414/minoborony_rossii_izdalo_metodichku_po_shturmovym_deyistviyam_po_opytu_voyiny_protiv_ukrainy_dokument>, accessed 14 May 2023.

In the defence, Russian forces largely occupy company fighting positions with platoon-sized elements that utilise minefields and obstacles to slow down and fix attackers before calling for heavy defensive artillery fire.¹⁹ If forced from their positions, they will utilise artillery fires to prevent either breakthroughs or consolidation by the attacker. Although Russian defensive operations have been criticised as being overly positional, they do hold ground combat units in reserve for mobile defence. Although their less capable units have consistently proven sluggish and reactive, on occasion they have launched rapid, aggressive counterattacks to retake lost positions in response to successful Ukrainian assaults.²⁰

It is notable that Russian doctrine, with a heavy emphasis on direct and indirect fires, has long prescribed that formations should dig in as soon as possible when static. If no engineering support is available, they are to do so by hand, and are to continue to improve their positions for the duration that they occupy them. As a result, Russian positions often include an extensive range of well-prepared fighting positions. Once Russian troops have taken a position, it is reliably fortified within 12 hours through the digging of fox holes or blasting on less favourable ground.²¹ This is rapidly augmented in frontline positions with cut-down trees to create strongpoints for support weapons. Positions are reinforced with concrete where possible, although this is rarely the case in the first line. They also make limited use of decoy positions to obscure the layout of their actual defensive positions and fires plan, although the extent of this practice varies across units.

Although Russian defence lines are significant and the units holding them post sentries, the Russians make very little use of observation or listening posts pushed forward of their main positions. Active reconnaissance, other than advancing to contact with disposable troops, is largely carried out by UAVs. Indeed, Russian troops appear to be reluctant to expose themselves through reconnaissance. Even when reconnaissance units work forward, it is usually to launch UAVs. It is typical for there to be between 25 and 50 UAVs from both sides operating over the contested area between the forward line of own troops (FLOT) and forward line of enemy troops (FLET) at any given time for each 10 km of frontage.²²

Overall, this force structure is a cynical but coherent solution to the problem facing the Russian Ground Forces; they are able to mobilise large numbers of personnel but most units are poor quality and suffer from a chronic lack of training capacity that might otherwise rectify the problem. The segmented tasking within an unevenly trained force places correspondingly uneven

19. Author interviews with a senior Ukrainian officer responsible for engineering J5 (L), Ukraine, April 2023.

20. Author interviews with A; author interview with D; author interview with E; author interview with G; author interview with H; author interview with a Ukrainian assault tactics instructor (M), Ukraine, April 2023.

21. Author interview with L.

22. Author interview with Deputy Commander of Ukrainian CEMA command (S); author interviews with A, Ukraine, April 2023; author interview with a Ukrainian UAV specialist (T), Ukraine, October 2022.

burdens on its different components. The losses among disposable infantry are extremely high. Conversely, because specialised troops are largely held back and often fight from well-prepared positions, the Russians are able to preserve these soldiers thereby steadily increasing the skill of these operators. Meanwhile, assault troops are preserved from some of the worst of the fighting and receive better body armour and equipment. They are often only committed under the most favourable circumstances, meaning they can achieve their objectives and be rotated out with limited losses. On the other hand, when they are committed under less favourable circumstances, whether because of Ukrainian deception measures or miscalculation by their command, these forces are assigned the most dangerous task and are thus prone to mass casualty incidents. It is also worth noting that the competence of these units varies considerably and depends on the proportion of replacements in the force, the level of training received and their resulting unit cohesion. VDV and naval infantry units, for example, have seen significant qualitative decline over the course of the war owing to regeneration. By contrast, because Wagner assault units often comprise companies, they are either lost or succeed. Moreover, the higher pay attracts experienced personnel from contract infantry and leads to more capable specialist Wagner units.

The critical and yet most elusive variable in assessing the strength of Russian military units is morale. Generally, it is low, with a rise in prosecutions for desertion,²³ observed instances of wounded comrades being abandoned, and very little depth of junior leadership. Personnel are also rarely rotated and there is considerable weariness across the force. In theory, this should make Russian units brittle. In practice, they appear to be able to take very heavy punishment without collapsing. Instead, morale problems appear to manifest in poor cooperation within units and even less between them. The result is a tendency for coordination and cohesion to fracture under pressure. This is likely to make Russian units underperform in defence if they can be forced to move or engage in a dynamic action.

23. Anna Pavlova, 'When Soldiers Say No. Hundreds of Russian Servicemen Face Trial in Defiance of Ukraine Deployment, Mediazona Study Reveals', *Mediazona*, 11 April 2023, <<https://en.zona.media/article/2023/04/11/500>>, accessed 13 May 2023.

Engineers

PERHAPS ONE OF the least discussed elements of the Russian forces during the full-scale invasion of Ukraine has been its engineers. In contrast to much of the Russian forces, its engineers have performed well. The aforementioned speed with which Russian infantry dig, and the scale at which they improve their fighting positions, is noteworthy and is supplemented by combat engineers. Two engineer companies are assigned to each brigade, one focused on mining and the other on force protection engineering.

Russian force protection engineering has largely followed its doctrine, with little methodological change since the Cold War. Russian defensive positions generally comprise two to three lines, depending on the context. The first line, along the line of contact, comprises the fighting positions made by the infantry. The second constitutes properly made trenches – as compared with fox holes in the first – and concrete firing posts where possible. Several obstacle belts are laid in front of these positions, usually formed with a 4-m-deep and 6-m-wide anti-tank ditch, dragons' teeth and wire track entanglements.²⁴ The trench positions are usually structured as company fighting positions in wood blocks and on ridge lines, placed to cover areas of open ground with fire, rather than as contiguously occupied front lines. The depth of the defence line is usually 5 km from the first, and each belt of physical defences tends to span between 700 m and a kilometre, so that the entire obstacle series is covered by fire. The third line usually comprises fall-back fighting positions and concealed areas for reserves, with positions dug for vehicles. Command posts (CPs), meanwhile, tend to be subterranean and fortified with concrete.²⁵ The overall depth of defensive fortifications exceeds 30 km on some axes.

Minefields are another element of the Russian defence line. These rarely follow a discernible pattern and are seldom marked. Ukrainian forces note that the Russians have no shortage of mines, creating mixed fields containing both anti-tank (AT) and anti-personnel (AP) mines. Russia is not a signatory of the 1997 Ottawa Treaty,²⁶ meaning its forces freely utilise victim-initiated AP mines.²⁷ They tend to leave lanes for rearward movement between the forward, first and

24. Author interview with D; author interview with L; author interview with M; author interviews with an officer responsible for preparing assault troops (N), Ukraine, April and May 2023; author interview with a senior officer responsible for assessment among Ukraine's international partners (O), May 2023. Author observation of Russian defensive positions in Ukraine and sample positions utilised for Armed Forces of Ukraine training serials in 2023.

25. Author interview with L.

26. 'Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on Their Destruction', <<https://geneva-s3.unoda.org/static-unoda-site/pages/templates/anti-personnel-landmines-convention/APLC%2BEnglish.pdf>>, accessed 4 May 2023.

27. Rich Wordsworth, 'Russia has Turned Eastern Ukraine into a Giant Minefield', *Wired*, 21 December 2022, <<https://www.wired.co.uk/article/russian-landmines-ukraine-psychological-warfare>>.



Ukrainian engineers on a pontoon bridge, Ukraine, April 2023. Courtesy of Jack Watling

second defence lines. There is also a strong preference for mining the approaches to natural choke points. In some cases, an AP mine may be placed directly on top of the AT mine. Initiation mechanisms are also often mixed. It is common for AP mines, for example, to be initiated by a seismic sensor and to have an immediately adjacent mine initiated by wires, which are laid out in a cross from the device. The Russians have also made extensive use of magnetically activated AT mines delivered via multiple launch rocket systems (MLRS). Although Russian forces have been successful in tracking the routes through their own minefields, they have performed less well in breaching mine belts laid by the AFU.²⁸

Another area in which the Russians have demonstrated persistent competence is in the emplacement of bridges. These are largely held at the Combined Arms Army level and assigned to support operations. Engineering units usually emplace them rapidly and there is no evidence that the Russian Ground Forces lack for pontoon bridges, even if their river crossing operations have exhibited serious shortcomings overall.²⁹ Russian forces are sufficiently confident that they can rapidly deploy bridging that they have at times destroyed bridges, even on routes that they intend to utilise, because they assess that the disruption to Ukrainian forces is greater than the burden of having to erect pontoons across the gap.³⁰

accessed 14 May 2023.

28. Tim Lister, “‘Like Turkeys at a Shooting Range’: Mauling of Russian Forces in Donetsk Hotspot May Signal Problems to Come’, *CNN*, 14 February 2023.
29. Joe Needham, ‘Crossing the Siverskyi Donets: Lessons for Wide Wet Gap Crossing Operations’, 23 Amphibious Engineer Squadron (lessons learned document), May 2022.
30. Author observations of Russian demolitions and diversion routes, Ukraine, June and October 2022, and April and May 2023.

Artillery

ARTILLERY REMAINS AT the heart of the Russian military. During the initial invasion, between one and two batteries of howitzers were assigned to each BTG along with an MLRS battery. By summer 2022, the Russians had consolidated artillery into artillery tactical groups. Russia is currently utilising artillery brigades, which allocate batteries in support of axes, and hold a significant force under direct command for counterbattery fire and to support the sector's main effort. Russian fires continue to be the main shaping effect on the fighting. The rate of Russian fire during the first quarter of 2023 fluctuated between 12,000 and 38,000 rounds per day. The number of days in which Russian fires exceeded 24,000 rounds is now much scarcer, and it is notable that – in terms of the allocation of fires – Russian artillery ammunition and barrel allocations are assigned to fewer priority axes. There has also been a shift in the calibres being most widely utilised with a relative reduction in the volume of 152-mm fire and a significant increase in the volume of 120-mm mortar fire. Thus, whereas total ammunition expenditure in 2022 was approximately 12 million rounds, fluctuating between 20,000 and 60,000 rounds fired per day, Russian fires in 2023 are currently trending closer towards 7 million rounds if the current rate of fire is maintained for the remainder of the year. Ukrainian estimates place current Russian shell production at 2.5 million rounds per year.³¹ This is likely to increase, although access to explosive energetics constrains it. Due to the disparity in expenditure versus production, additional rounds are purchased from the international market.³² Nevertheless, with a projected consumption rate of 7 million rounds over the whole of 2023, Russia will have to be more discerning in where it prioritises its fire.

Ammunition availability has shaped employment. The Russians had no difficulty in amassing ammunition around their guns in Donbas in summer 2022. After HIMARS strikes disrupted these supply practices, and the availability of accurate long-range Western howitzers in the AFU made this stockpiling difficult, the Russian approach to fire control was disrupted. What has followed has been a process of experimentation and refinement that is beginning to produce new tactics. The Russians have introduced two terms into their fires lexicon: 'immediate value'; and 'weight of salvo'. The first reflects the uneven effects of fire based on the tactical context and thus the need for precise timing of the delivery of fires in relation to the wider actions of a unit. Thus, fires planning is now framed as a series of decision points. The second – weight of salvo – is also reflective of a shift in emphasis to the timing of effects, desiring to land the greatest weight

31. Author interview with F; author interview with a Ukrainian official focused on assessments of industrial capacity (P), Ukraine, March 2023.

32. Victor Cha, 'North Korea Sends Ammunitions to Russia', CSIS, 7 November 2022, <<https://www.csis.org/analysis/north-korea-sends-ammunitions-russia>>, accessed 13 May 2023; Dion Nissenbaum and Benoit Faucon, 'Iran Ships Ammunition to Russia by Caspian Sea to Aid Invasion of Ukraine', *Wall Street Journal*, 24 April 2023; Evan Hill et al., 'Egypt Secretly Planned to Supply Rockets to Russia, Leaked U.S. Document Says', *Washington Post*, 11 April 2023.

within a defined period to maximise effect. The patterns of fire are being described as ‘Nomadic Cannon’, ‘Fiery Carousel’, ‘Roaming Platoon’ and ‘Umbrella Cover’. The Nomadic Cannon reflects harassing fire, delivered from mobile firing points, often to draw counterbattery fire or conduct artillery raids. The Fiery Carousel reflects a means of maintaining survivability while sustaining barrage. The Roaming Platoon concept envisages manoeuvring guns maximising the weight of salvo deliverable against a target. Umbrella Cover is essentially a means of suppression.³³ Gun positions are no longer dug. Instead, a battery will conceal itself in a woodblock and move to a firing position where ammunition will have been placed for a defined salvo.³⁴ It will then move to the next. If fixed by counterbattery fire, operators tend to leave their guns and seek cover, only returning to them when it is safe to do so.

Fire is not only used to strike Ukrainian defensive positions but also, vitally, to blunt assaults.³⁵ If the Russians learn that an assault is being prepared, the area is often saturated with fire to prevent its execution. Another common tactic is for the Russians to withdraw from a position that is being assaulted and then saturate it with fire once Ukrainian troops attempt to occupy it. Ukrainian forces report that while the weight of artillery fire remains high, MLRS launches are significantly less than in previous months, suggesting munitions shortages. It appears that Russia has a steady supply of Krasnopol laser-guided 152-mm rounds as there is an observed increase in the number of Orlan-30 flights and the use of designators by specialised infantry to deliver more accurate strikes on Ukrainian defensive positions.³⁶ Russian counterbattery fire has also shifted away from the saturation of detected Ukrainian positions to the firing of Lancet loitering munitions. Although these have a limited success rate, their speed and accuracy make it challenging to maintain sustained firing for Ukrainian guns to support manoeuvre. Lancets are also used for reconnaissance to actively hunt for Ukrainian artillery.³⁷

More consequential than adaptations in firing sequences has been the refinement of the Russian Reconnaissance Fires Circuit (Russian term for the kill chain) to make it more responsive and more flexible in delivering fire to support manoeuvring forces. Each commander of an axis will generally retain an orbit of Orlan-10s above the fighting to provide both information to the CP and targets for responsive and accurate fire to the assigned batteries. The artillery brigade commander also often retains several Orlan-10s, coordinated in a complex above areas of interest. Thus, Ukrainian forces often find that they are being observed from two different Orlan-10 complexes – each able to call down different effects.³⁸ The time for artillery engagements

33. Overview of developments in Russian artillery doctrine, shared by the Ukrainian General Staff, May 2023.

34. Author interviews with an officer who led offensive operations on the Kherson axis (U); author interviews with K; author interview with L, Ukraine, April 2023.

35. Author interviews with A; author interview with C; author interview with E; author interview with H; author interview with D; author interview with M.

36. Author interviews with A; author interview with H; author interviews with K.

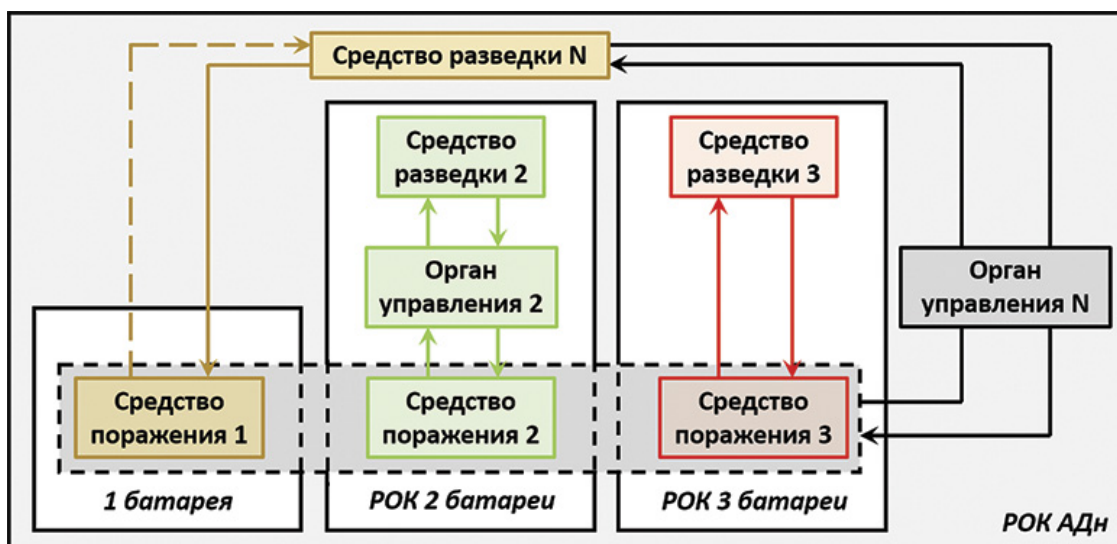
37. Author interview with D; author interview with T.

38. Author interview with S.

from these systems remains rapid at around 3–5 minutes. Engagement from electronic warfare (EW) detection is longer at around 20–30 minutes.³⁹

One underappreciated aspect of Russian fires reconnaissance early in the conflict was the Strelets system. It allows multiple feeds from ground-based sensors or detections by reconnaissance troops to be programmed and transmitted through a wide range of bearers, which are then integrated into Russian digital fire control.⁴⁰ Few Russian units were found to have Strelets during the initial invasion, and even among those that had it, it was often not set up properly or left in baggage. Although the low quality of training among Russian troops means that it is still not prevalent, it is widely used among specialist infantry assigned to VDV and Wagner formations. These personnel use Strelets to either place sensors close to Ukrainian positions or report and correct for fire for Russian artillery to enable accurate engagements.⁴¹ The combination of calls for fires enabled by Strelets, combined with the Reconnaissance Fire Complexes (RFCs) of higher echelons fires using organic ISR is outlined in Figure 1. The figure shows three interlocking kill chains or ‘reconnaissance fires circuits’ from a direct link between reconnaissance and fires assets, to a link between reconnaissance assets through a fire control to a battery, and the ability of a higher headquarters to assign alternate ‘means of destruction’ against a detected target.

Figure 1: Model of the Reconnaissance and Fire Circuit Formed During Hostilities in Ukraine



Source: Overview of developments in Russian artillery doctrine, shared by the Ukrainian General Staff, May 2023.

39. *Ibid.*

40. Lester Grau and Charles Bartles, ‘Russian Artillery Fire Control for Large-scale Combat Operations’, *Fires* (May–June 2019), pp. 13–14.

41. Authors interviews with K.

The actions of Russian assault groups against the village of Artemivske in December 2022 provides a useful illustration of the application of the RFC as it has developed in Ukraine. Several UAVs were used to fly above the assault groups in the city: one conducted reconnaissance outside the city against the positions of the Ukrainian artillery; another maintained observation over possible routes for transferring reserves; a third preceded the assault group to identify Ukrainian ambushes and firing positions; and a fourth flew above the assault group itself, giving the assault group commander real time observation of the tactical situation. If any of the UAVs identified a target, the UAV operator would pass the coordinates to the assault group commander. If the target was to be engaged with artillery this would be either ordered by the assault group commander and carried out by the artillery attached to the group, or transferred to the higher command, operating its own UAVs over the area, which could take over the fire mission with its assets. In this instance, the engagements were managed by the Strelets system. The applied architecture for this bypassing of centralised fire control for the delivery of effects through a tiered RFC is outlined in Figure 2. In the figure, information flows from the UAV both to the CP, but also to a fire observer directly to the barrels via the Strelets system, indicated by the black line. Thus the commander is on, but does not need to be in the loop for the engagement to proceed.

Figure 2: Approximate Scheme of the Management of a Mortar Platoon of the AFRF in the Absence of the Platoon's Command and Observation Post



Source: Overview of developments in Russian artillery doctrine, shared by the Ukrainian General Staff, May 2023.

Armour

THE RUSSIAN USE of armour has evolved significantly during the conflict. The BTG concept included the use of armour in company groups to punch into operational depth.⁴² After taking massive losses, the Russians shifted to using armour for attempts at breakthrough when conditions were propitious. Now, tanks are very rarely used in this way, with the destruction of a Russian naval infantry brigade in Vuhledar attempting such an armoured thrust, reinforcing Russia's caution in using such tactics under current conditions.⁴³

Instead, tanks tend to operate in three ways. First, they are used to supplement artillery capabilities through indirect engagements. This is particularly notable in sectors off the Russian main effort where there is not a sufficient allocation of air defences to protect a robust logistics architecture capable of supporting a large numbers of guns.⁴⁴ Because of the low angle of indirect fire engagements by tanks, they make for an inefficient form of artillery. Nevertheless, these engagements can often be made from positions that would not be viable for artillery because of the tanks greater protection and thus reduced vulnerability to counterbattery fire, enabling tanks to fill in the gap in firing while guns displace or become suppressed.

Second, tanks are used as highly accurate fire support assets able to stand off at 2 km and utilise their enhanced optics to identify and knock out firing positions. It is important to note that while the introduction of older tanks such as the T62 and T55 to the field has been mocked online, these vehicles are largely being used in the role of the fire support function offered by BMPs and other infantry fighting vehicles (IFVs). They represent an increase in range, protection and kinetic effect over these IFVs, and therefore pose a serious battlefield threat when there are a limited number of anti-tank guided weapons able to reach them at their stand-off range.

A third use of armour is in raiding. Because of the continual pressure that Russian infantry place Ukrainian positions under, this requires regular troop rotations. Striking troops during these rotations significantly increases the likelihood of inflicting casualties, so the Russians often conduct gun raids with tanks when they detect troop rotations.⁴⁵ These are often carried out at

42. Grau and Bartles, 'Getting to Know the Russian Battalion Tactical Group'; Lester W Grau and Charles K Bartles, 'The Russian Breakthrough Tactical Group', *Infantry* (Vol. 111, No. 3, Fall 2022), pp. 14–17.

43. Mike Eckel, 'What Happened in Vuhledar? A Battle Points to Major Russian Military Problems', *Radio Free Europe/Radio Liberty*, 17 February 2023, <<https://www.rferl.org/a/ukraine-russia-battle-vuhledar/32276547.html>>, accessed 14 May 2023.

44. Author interview with a Ukrainian tank battalion commander (V); author interview with a staff officer in a Ukrainian operational command (W), Ukraine, May 2023.

45. Author interview with W; author interview with G.



night, specifically utilising T80BV with its better thermal optics. The aim is to rapidly approach the target sector, fire as many rounds as possible within a short space of time and withdraw.

One important development is that the Russians have made several modifications to their tanks that are reducing the effectiveness of anti-tank guided missiles (ATGMs). First, they are fitting vehicles – as well as many defensive positions – with anti-thermal material,⁴⁶ which is proving highly effective. Second, modification to the engine deck and thus the heat plume from the vehicle’s exhaust and engine is reducing the reliability of where certain ATGMs engage the target. Third, by fighting at dusk and dawn when the vehicle temperature is most similar to the ambient temperature of the surroundings (known as ‘thermal crossover’), the vehicles are harder to detect through thermal imagery.⁴⁷ The result is a significant decrease in the probability of kill from several ATGM types, although this is only achievable by imposing a range of tactical constraints on the employment of Russian armour.

Exceptions to the patterns outlined above can be found in urban fighting where distances often collapse. Although Russian forces have proven very cautious in using armour in Bakhmut, they have pushed armour in a supporting fire role for infantry in other urban battles. Here, tanks have proven critical for both suppression of urban structures and rapid breaching of buildings to avoid entering through choke points and known avenues of advance. The use of older tanks as assault guns in this role appears to be preferred as the urban environment does not give more modern Russian tanks with advanced optics and multispectral concealment a sufficient tactical advantage to justify their loss. Of course, as tanks are drawn into urban areas for this purpose,

46. Author interviews with K; author interview with D; author interview with G; author interview with V.

47. Author interviews with B, Ukraine, March and May 2023; author interview with G.



Ukrainian Territorial Defense Forces approach a damaged building, Ukraine, May 2023.
Courtesy of Jack Watling

they also risk coming into direct contact with enemy armour, with armoured clashes sometimes taking place from distances as close as 50 m.⁴⁸

Tank-on-tank engagements have become relatively rare, but when they occur they usually take place within 1,000 m. Engagement speed has been the determining factor in these clashes. Ukrainian tankers note that one-shot kills are possible if the point between the turret and glacis is hit. Russian explosive reactive armour (ERA), however, has proven highly effective, preventing most anti-tank systems from defeating the tank's armour.⁴⁹ Some operators have reported hitting tanks multiple times with barrel-launched ATGMs without knocking them out. Significantly, Ukrainian tankers report that mobility kills against the vehicle's tracks are also an effective means of removing Russian armour from the field because they usually cause the crew to abandon the vehicle.⁵⁰ This is because a tank's mobility is considered the best means of protection against artillery and its survivability is compromised if it is immobilised. On several occasions, this tendency for stricken armour to be abandoned has led to extended skirmishing by both sides to try and recover damaged vehicles. On balance, Russian fires superiority tends to prevent Ukrainian troops from successfully lifting enemy armour under these conditions, meaning the vehicles are usually denied with artillery to prevent their recovery and repair.⁵¹

48. Author interviews with a Ukrainian tank crew (X), Ukraine, April 2023; author interview with V.

49. Author interview with D; author interviews with K; author interview with G; author interviews with X.

50. Author interview with G; author interview with I; author interview with V; author interviews with X.

51. Author interview with a Ukrainian deputy brigade commander (Y), Ukraine, May 2023.

Electronic Warfare

ELECTRONIC WARFARE REMAINS a critical component of the Russian way of fighting. While there was an extremely high density of EW systems in Donbas in 2022, the AFRF now employ approximately one major EW system per 10 km of frontage, usually situated approximately 7 km from the frontline, with more specialised EW capabilities sat at higher echelon.⁵² These platforms are usually aimed at controlling and defeating UAVs. Interestingly, there is minimal interest among Russian crews in synchronising these effects with other activities or with deconflicting their effects. Instead, for the period when an EW team is deployed, it is weapons free with its system and tends to aggressively attack Ukrainian systems. The Shipovnik-Aero is proving a particularly effective system because it has a low signature and can further obfuscate this by imitating other emitters and communications devices.⁵³ It also has a sophisticated range of effects for downing UAVs.⁵⁴ The Russian military is also continuing to make extensive use of navigational interference in the battle area as a form of electronic protection. This is contributing to a Ukrainian loss rate in UAVs of approximately 10,000 per month.⁵⁵

Another function of Russian EW troops is interception and decryption of Ukrainian military communications. The Russian military is proving highly capable in this area. Ukrainian officers recalled one incident in which the Russian headquarters gave pre-emptive warning to its units of an artillery strike based on Ukrainian troops calling in a fire mission.⁵⁶ The Ukrainian troops were communicating with Motorola radios with 256-bit encryption, but it appeared that the Russians were able to capture and decrypt these transmissions in near real time. The most likely system for such functions is the Torn-MDM.⁵⁷ When the Russians are not intercepting traffic, Ukrainian units note that they are reliably able to suppress the receivers on Motorola radios out to approximately 10 km beyond the FLET.⁵⁸

Alongside large systems such as the Shipovnik-Aero, the Russian military has been extensively rolling out EW effectors to be organic to units at all echelons. This includes counter-UAS capabilities assigned to each platoon,⁵⁹ which usually include directional jammers and arrays for hijacking UAVs. Ukrainian forces now assess that at least one of these systems is available

52. Author interview with S.

53. Technical assessment of this system conducted in Ukraine, July 2022.

54. Author interview with S; author interview with T.

55. Author interview with B; author interview with T; author interview with O.

56. Author interview with G; author interview with I.

57. Technical assessment of Torn-MDM conducted in Ukraine, June 2022.

58. Author interview with a Ukrainian brigade commander (Z); author interviews with A; author interview with G.

59. Author interviews with K; author interview with S; author interview with I.



A platoon UAV hovers in overwatch above a defensive position, Ukraine, April 2023. *Courtesy of Jack Watling*

to each platoon within Russian line infantry units. Another EW function in the counter-UAS fight is deception measures that generate a large number of fake UAVs on enemy systems and replicate ground control stations. While the Russian military is yet to widely exploit the creation of a large number of false targets, it has the capability to do so – and these actions are growing more prevalent.

Air Defence

THE PERFORMANCE OF Russian air defence systems has steadily improved. Early setbacks due to poor coordination and planning saw Ukraine successfully strike Russian formations during the initial week of the war.⁶⁰ The Russians rapidly established a more robust coverage over their tactical formations, which quickly denied airspace to the Ukrainian Air Force. Nevertheless, this was premised on a large number of dispersed air defence systems, and these proved vulnerable to complex attacks involving anti-radiation missiles and EW effects. The Russians also found that dispersed air defence systems were incapable of intercepting a range of threats, including guided multiple launch rocket systems (GMLRS) used to devastate Russian command and control and logistics in July 2022.

Russian air defences have become significantly more robust since the autumn of 2022. Complexes of SA-21 and SA-23 are now stationed around key logistical and C2 hubs. Critically, they appear to have SA-15 and SA-22 connected to their fire control radars, significantly improving the situational awareness and track data quality of these short-range air defence (SHORAD) systems. This has had two principal effects. First, the long-range radar, combined with systems such as the 48Ya6 'Podlet-K1' all-altitude radar, have proven highly effective in denying airspace to Ukrainian aviation. Second, Russian SHORAD systems have massively improved their point defence efficiency. Along with the successful interception of most high-speed anti-radiation missiles (HARMS) fired by Ukrainian aircraft, the Russian air defence network is now assessed to be achieving a significant number of intercepts against GMLRS munitions.⁶¹ The exact intercept rate depends on the depth of the target and the number of GMLRS fired, so that a precise proportion of intercepts cannot be meaningfully given. Russian air defences are clearly much more effective in defence when they can be properly connected, than in a dynamic context where they are having to cover advancing forces. This allows Russian crews to achieve optimal efficiency against the current range of threats. It is noteworthy however that Russian crews have always lagged in reacting appropriately to new threats, and struggle to maintain effective blue force tracking, leading to several blue-on-blue engagements.

The efficiency of Russian long-range surface-to-air missiles (SAMs) against the Ukrainian Air Force has also remained significant. The longest-known shoot-down against Ukrainian aircraft was at 150 km when the aircraft was flying lower than 50 feet.⁶² This appears to have been cued by a 48Ya6 'Podlet-K1' all-altitude radar with the air defence missile achieving a post-apex lock on the target. The strength of the air defence network is bolstered by persistent combat air patrols at medium altitude by Russian Su-35s. Using R-37 missiles, these aircraft pose a

60. Author interview with a Ukrainian air force sector commander (AA), Ukraine, August 2022.

61. Author interview with a Ukrainian official responsible for battle damage assessment (AB); author interview with B; author interview with O.

62. Author interview with B.

significant threat at very long range. According to the Ukrainian Air Force, the longest-range recorded kill by a Russian R-37 was at 177 km.⁶³ Although separate from the air defence system, the combination of threat from long-range ground-based anti-air capabilities, medium-altitude look-down radar, long-range air-to-air missiles, and effective point defence systems makes the air combat environment extremely lethal. For this reason, most Ukrainian fast air and attack aviation engagements utilise S-7 rockets, fired in a lofted profile from above Ukrainian positions.

63. *Ibid.*

Aviation

DESPITE THE GREATER density and integration of Russian air defences, the VKS continues to be reluctant to push into Ukrainian airspace. Russian aviation has largely continued to conduct stand-off attacks. First, aviation-launched cruise missiles now constitute the majority of stand-off effects used for the protracted targeting of Ukrainian sites.⁶⁴ The Tu-95 fleet remains the backbone of this capability. It is noteworthy that a large number of aircraft are assigned to these strikes, with a relatively small proportion of aircraft firing the munitions. Here, the VKS has adapted in response to the limited number of strikes possible per month leading to Ukrainian defences gaining significant warning time of strikes through the take-off of these aircraft. Given that Russian industry can deliver approximately 40 long-range missiles of varying types per month, the VKS launches large numbers of aircraft to increase the number of potential axes of threat, using Shahed-136 UAVs as pathfinders to identify gaps in Ukrainian air defence and then firing from a small number of aircraft to maximise the proportion of missiles that reach their target.⁶⁵

Stand-off effects are also the principal means of the VKS conducting strikes in tactical depth, largely employing FAB-500 bombs with glide kits launched from Su-35s; with a potential range of up to 70 km, these munitions have relatively poor accuracy. The AFU notes that the VKS holds substantial stockpiles of FAB-500s and is systematically preparing glide kits for them, potentially providing a large number of available heavy bombs. For now, Russian use of these munitions has been small, although strikes have been persistent. It is anticipated, however, that these strikes are providing data for the refinement of the glide kits and, more importantly, for the calculation tables used to determine when they are released, which may see an improvement in accuracy over time. If employed with greater concentration, it is also anticipated that this capability will begin to be employed against battlefield targets.

The other stand-off strike method is lofting S-8 unguided rockets from both fast air and aviation assets on a long arcing trajectory at distant targets. The technique, first seen soon after the invasion, has been the subject of significant curiosity due to its inefficiency and inaccuracy.⁶⁶

64. Ian Williams, 'Putin's Missile War: Russia's Strike Campaign in Ukraine', CSIS, May 2023, p. 25, <https://csis-website-prod.s3.amazonaws.com/s3fs-public/2023-05/230505_Williams_Putin_Missile.pdf?VersionId=0rahER.P81oo5ispb8.UGcT_90DmLoSb>, accessed 13 May 2023; author observations of composition of strikes in October 2022 as compared with March and May 2023.

65. Author interview with a senior officer in Ukrainian air defence (AC), Ukraine, March 2023; author interview with an expert on Russian defence industry from Ukraine's intelligence community (AD), Ukraine, March 2023.

66. Thomas Newdick, 'Russian Attack Helicopters are Now Wildly Lobbing Rockets Over Ukraine (Updated)', *War Zone*, 18 March 2022, <<https://www.thedrive.com/the-war-zone/44803/russian-attack-helicopters-are-now-wildly-lobbing-rockets-over-ukraine>>, accessed 3 May 2023.

However, when conducted at ranges of approximately 12 km at area targets such as Ukrainian ground formations attempting to form up for attacks, the concentration of effect has proved sufficient to break up these formations and prevent attacks from taking place. Interestingly, these lofting strikes appear to be the primary use of Russian attack aviation on the current battlefield. Although the technique is used across the front, its most pronounced effects are in areas where the Russians have a dearth of ground-based fires, as the responsiveness of this method of attack can increase the threat to Ukrainian troops with very little notice. The second use of Russian aviation is the application of EW effects. There are believed to be eight Russian Mi-17s with EW suites operating in southern Ukraine. These are being utilised to some effect for the purposes of electronic attack against Ukrainian command and control, and through their altitude are able to do so in greater depth than is achievable by comparable systems based on the ground.⁶⁷

The VKS remains something of an enigma in the conflict. On the one hand, it retains significant firepower and a large fleet of available aircraft with munitions. On the other hand, its presence is limited. The challenge for Ukraine is that Russian fast air, and particularly its large extant attack aviation fleet, could inflict massive damage if committed in numbers, even if this would be costly. So long as this represents a latent threat, it must have a shaping effect on Ukrainian offensive operations, as advancing Ukrainian forces are likely to face similar challenges to the Russians in advancing their air defence coverage.

The prize to be fought for in this regard is the ability to operate at medium altitude beyond the engagement ceiling of shoulder-fired man-portable air-defence systems (MANPADS). Whichever side can operate sustainably in this altitude band can more easily identify targets and bomb with much greater range and accuracy. At present, the VKS is deterred by the SAM threat from adopting such a profile over the Ukrainian frontlines. However, probably the single greatest extant threat that could change the tactical dynamics on the ground is if the VKS gains the freedom to operate at medium altitude over Ukrainian positions.

67. Author interview with S.

Command and Control

GMLRS STRIKES BY Ukrainian forces in July 2022 pushed Russian headquarters back to beyond 120 km from the FLOT. In autumn 2022, this distance imposed significant tactical challenges on Russian forces. However, these challenges had largely been overcome by winter. Russian headquarters are now more dispersed and are connected to forward CPs by wiring. This has often been achieved by commandeering the Ukrainian telecommunications network on the occupied territories, which is dense and robust.⁶⁸ The Russian military then connect its CPs to the closest point in the civilian network via extended ground-laid telecommunications cables. Brigade CPs remain pushed back from the front line, usually to a distance of 20 km, but are often well protected, being situated underground in reinforced structures.

The dispersion of orders from CPs to key assets such as air defence, EW and other systems has been observed to depend on microlinks in the first instance, often using relay vehicles to increase the range at which combat management can be carried out. Microlink use has significantly decreased the detectability of these systems. It is noted that brigade to battalion CPs are often either connected via microlink relays or field cable, which are usually laid within 24 hours of a CP being established.⁶⁹

In contrast to the low detectability of these command links, Russian communications from the battalion CP downwards are not just dependent on radios but often on analogue military systems and tend to be communicated in clear rather than encrypted. This is presumed to be the result of the limited training provided to many components of the force. Moreover, while some units have developed forms of veiled speech, most do not adhere to these practices. The exception to this is among reconnaissance units and artillery observers able to utilise systems such as Strelets and Azart.

As regards cooperation between units, Russian forces continue to struggle to be horizontally integrated in their C2. The layering of fires, for example, between combined arms army assets, brigade artillery and battalion mortars, demonstrates reasonable fires integration between echelons. However, there is limited application of cross-boundary fires between sectors. Nor is there much evidence that units have the means to communicate laterally. Instead, information is passed upwards, then across at the brigade level or higher, and then downwards. This is a major limitation in Russian defensive operations as it creates seams that must be covered by higher echelons with organic assets. Integration of VKS capabilities also remains tied to the Combined Arms Army CP.

68. Author interview with S.

69. Author Interview with S; author interview with Q.

Priority Assistance for the Armed Forces of Ukraine

AS UKRAINE PREPARES for offensive operations, it is important to consider the tactical challenges that the AFU will face. How Ukraine plans to overcome these challenges is operationally sensitive and will not be detailed in this report. Nevertheless, some priorities for those supporting Ukrainian forces can be identified through the analysis of Russian capabilities outlined above, and by some of those issues facing the AFU which are already clearly identifiable in open sources. Russian infantry, when properly supported, can make Ukrainian offensive operations challenging. Specifically, the volume of Russian fires, their protection by air defences, the extent of Russian force protection engineering, and the ability to disrupt mobile command and control all represent tactical challenges.

While Russia's defensive operations are positional, a cardinal sin among adherents of manoeuvre warfare,⁷⁰ defeating the layers of prepared defences still presents a problem. These defences are not absolutely positional, with Russian forces utilising some mobile reserves at the tactical level. The depth of the defences means that Ukraine must generate serious combat power to penetrate the Russian lines, and the extent of Russian defensive fortifications across the front makes bypassing them nearly impossible. Even if Ukrainian forces achieve a breakthrough in future, and regain their ability to manoeuvre, this will require localised breakthroughs and mopping up operations against bypassed defensive positions. This means that, although there are a variety of likely tasks for Ukrainian ground units and they will need to be able to manoeuvre, training for assault operations against fortified positions constitutes a critical training priority for Ukrainian troops.

The first obstacle for Ukrainian forces is winning the indirect fires duel. In the face of enemy artillery dominance, offensive manoeuvre is extremely costly. Ukraine's international partners have provided a large number of artillery systems and the country is receiving a consistent supply of ammunition, although the natures provided do not always reflect the balance of calibres available to the AFU. However, the real issue is that the priority for provisioning Ukrainian artillery for defence has left its fires system lopsided in its capabilities. Ukrainian artillery has ample means to blunt Russian advances, with an effective fire control architecture and the ability to coordinate engagements from multiple dispersed guns. However, suppression of a superior number of Russian artillery systems requires counterbattery capabilities to rapidly

70. Pavel Baev, *Russia's War in Ukraine: Misleading Doctrine, Misguided Strategy* (IFRI Russie.NEI. Report No. 40, 24 October 2022), pp. 9–15, 23, <https://www.ifri.org/sites/default/files/atoms/files/baev_russia_war_ukraine_2022.pdf>, accessed 7 May 2023; Marco Hernandez and Josh Holder, 'Russia Has Built Vast Defences Across Ukraine. Will They Hold?', *New York Times*, 14 December 2022.

detect and engage enemy firing positions. It is evident that if Ukrainian forces are to set the conditions in any sector for offensive action, its international partners should prioritise the provision of detection systems for directing counterbattery fire.

Winning the firefight in direct engagements is also critical, as suppressing enemy positions during assault actions is essential. As regards heavy weapons, a significant emphasis has been placed on .50 calibre heavy machine guns equipping Ukrainian units. While these are highly effective, their fire has a very flat trajectory. They would be complemented well by automatic grenade launchers such as the Mk. 19 Grenade Machine Gun (GMG), which would pose a greater threat to enemy troops in trenches or dug into open positions, given the arcing trajectory of rounds. Assisting Ukrainian forces with winning the direct firefight is also worthwhile because, unlike some other capabilities, it can be improved in a standalone fashion, the training and weapons systems in question not requiring other dependencies to be in place before adding value.

Mine clearing and breaching is another area where Ukraine's partners must prioritise support. The key requirement is likely minefield reconnaissance. The utilisation of machine learning tools with UAV reconnaissance could be a means of identifying fields. Nevertheless, reconnaissance in this function is also likely to require human scouting and marking, which is a difficult skill and should be taught so Ukrainian reconnaissance troops can do this at night. It is also important to note that while offensive obstacle breaching at tempo is something that Western militaries have under-resourced, counter-IED equipment and tactics, techniques and procedures (TTPs) developed during the war on terror do have applicability. The challenge is adapting these to work under an indirect fire threat that was not significant when these tactics were first employed.

Much of the emphasis for international support has understandably been on equipment. Tactics, however, will be decisive in determining whether Ukrainian infantry are able to succeed on the battlefield, particularly the challenge of taking entrenched and fortified positions protected by minefields and supporting fires. While there are several critical skill sets that can be identified, there are a variety of common battle drills that are the bread and butter of well-trained ground combat and combat support units.

Unfortunately, Ukraine faces multiple pressures which serve as major impediments to honing the skills, tactical coordination and group cohesion of its units. It is required to deploy its best units on ongoing operations along an extended front line in eastern Ukraine. Furthermore, Ukraine's training establishments are having to process an influx of new recruits with limited prior military training. These recruits must both replace the casualties from existing units and facilitate the expansion of the AFU. This is no easy feat and comes after the training establishments were severely disrupted early in the war, including in some cases being physically overrun by Russian Ground Forces, or having the instructors and students mobilised at the beginning of the war as an emergency measure.

The scale of training assistance required should therefore not be underestimated, for it is substantial and complex. Collective training for units must be prioritised, with a particular focus on fire control for direct and indirect fire support units to maximise suppression without



Ukrainian infantry listen to their commanding officer, Ukraine, April 2023. *Courtesy of Jack Watling*

wasting ammunition, effective tactical command and control of, and between, fire support, engineering and assault units to ensure effective suppression during breaching and assaults without fratricide, and the conduct of assaults themselves. The relevant battle drills are not particularly complex conceptually, but they must be understood well enough by all involved for there to be no requirement to submit a planning process beforehand, or for that planning and delivery of orders to be quick and concise so as to minimise vulnerable pauses in operational activity. They require thorough practice under realistic conditions to build sufficient coordination to be effective, and for there to be the speed and momentum to prevent the enemy from responding effectively.

The need to build effective assault units with common tactics also speaks to a wider requirement for company-level collective training to ensure consistent TTPs and develop unit cohesion. Here, developing leaders who are able to coordinate multiple elements as part of platoon-, company- and battalion-strength tactical engagements at pace will be vital. The emphasis on individual soldiering skills in UK training provided to Ukrainian recruits, while an important foundation, underplays the vital importance of building formed units if offensive actions are to succeed. If this means slowing down the number of trainees passing through the UK programme by adding an additional couple of weeks of collective training, then the trade-off would be worthwhile.

If Ukrainian units break through the defences, it is vital that they can exploit the gap they have created. If their offensive operations lack momentum, this will lead to a series of sequential assaults against prepared Russian defences – a slow and disproportionately costly way to take ground. Conversely, they will maximise the return on the costs of each assault if they are able to breach and exploit forwards, thereafter, keeping Russian forces on the back foot. To do this, they must maintain tempo and remain protected as they move forwards. This leads to two

requirements. For the maintenance of tempo, the availability and serviceability of equipment is vital. While this can be done in defence by recovering vehicles and having trained mechanics work on them, the maintenance of equipment provided by international partners during offensive operations will largely depend on the proficiency of crews in keeping them fighting. For this reason, it is critical that there is an available stockpile of spare parts for all donated equipment, that user manuals have been translated into Ukrainian and distributed to the appropriate units, and that crews have time to properly familiarise themselves with equipment that follows a very different maintenance methodology from platforms on which they have previously operated.

A second critical requirement for maintaining momentum is the protection of forces that have broken through from counterattacks by those Russian forces held in reserve. Reserve manoeuvre elements can be fixed with artillery so long as they can be located. Defensive enemy artillery fire must be obviated by maintaining momentum and therefore denying the enemy real-time location data on targets. This means disrupting their means of holding units under observation. Meanwhile, protecting units from aviation is critical to prevent a responsive set of strikes to blunt a breakthrough. For the defeat of enemy artillery, some deployable EW capabilities may be useful, but whether for UAVs or aviation, tactical air defence is by far the greatest priority. The ability to have air defence move with and shield manoeuvre elements is a vital area that requires potentially novel support from Ukraine's partners.

Finally, the disruption of enemy counterattacks or strikes from artillery and aviation would be greatly assisted by the destruction of enemy command and control infrastructure. For this, suppression of the air defences protecting these targets will be important. Assistance in both stand-off electronic attack and the use of tools such as UAVs to threaten and displace air defences or else saturate them with false positives or non-economical targets could all greatly assist in creating confusion, overwhelming enemy decision-making and reducing the level of protection to maximise the impact of Ukrainian GMLRS strikes.

Conclusions

THE TENDENCY IN much of the international discourse surrounding the Russian military has been to write it off as tactically inept, technically deficient and morally broken. These criticisms have more than a grain of truth to them. Nevertheless, they tend to extrapolate from the performance of certain Russian units to the whole force. Alongside their deficiencies, Russian forces have demonstrated that much of their equipment is effective, highly lethal and adaptable to a range of threats. While there are serious deficiencies in Russian capabilities, these are most pronounced in conducting offensive operations. Conversely, many of Russia's combat support arms have not only demonstrated reasonable proficiency but have also shown that they are able to adapt to emerging threats.

Although Russian forces have started to resolve a range of tactical challenges besetting their forces, it is noteworthy that many of these adaptations are reactive. The role specialisation of infantry has been driven by an inability to train enough troops, not by proactive force design. The acceleration and simplification of fire control has been driven by failing to deliver effective responsive fires early in the war. It thus remains unclear the extent to which these adaptations will become permanent aspects of the Russian military. It is also evident that as an institution the Russian military continues to fail to anticipate new threats. Air defence units, for example, show a growing proficiency against threats over time, but the introduction of any new strike system or tactics on the Ukrainian side usually causes a period of disruption and friendly fire. Most of all it is evident that the Russian military is systematically struggling to coordinate different functions; this can be exploited. The callousness of Russian approaches towards its own personnel continues to ensure that they underperform versus their potential, usually because of poor unit cohesion.

The critical capability underpinning the Russian military remains its fires. Here, it is less clear that its approach is sustainable, or that the pace of adaptation is sufficiently fast. Ultimately Russia has used its massive stockpile of ammunition in a highly inefficient manner and is exceeding its manufacturing rate as regards both shells and barrels. Firepower has been employed by the Russian military as a crutch to compensate for its tactical shortcomings in other areas. If the weight of salvo the Russian military can generate diminishes then it is not at all clear that Russia's infantry can effectively hold ground. Perhaps the greatest danger for Ukraine, therefore, as regards the longer term trajectory of Russian forces, is if another country provides tooling and workers to establish additional production capacity in Russia for munitions and barrels.

Ukrainian troops, while superior in their morale and often in their training, continue to face a range of hard military tactical challenges in reclaiming their country's territory. Overcoming these challenges requires sustained and appropriately targeted support from their international partners that reflects the evolution of the tactical situation. Overcoming Russian forces will also increasingly depend upon the tactical proficiency of Ukrainian training, force generation, and

equipment maintenance, rather than on the introduction of additional systems. The complexity of Russian fortifications requires Ukraine to undertake a multifaceted process of shaping, breaching and exploitation demanding the preparation of its units and a range of complex capabilities. It is vital that Ukraine's partners prioritise establishing a sustainable process for individual, collective and staff training to the AFU. Ukraine, today, has the initiative. But as the Russian military adapts, there can be no room for complacency.

About the Authors

Jack Watling is Senior Research Fellow for Land Warfare at RUSI. Jack works closely with the British military on the development of concepts of operation and assessments of the future operating environment, and conducts operational analysis of contemporary conflicts. Jack's PhD examined the evolution of Britain's policy responses to civil war in the early 20th century. Jack has worked extensively on Ukraine, Iraq, Yemen, Mali, Rwanda, and further afield. Jack is a Global Fellow at the Wilson Center in Washington, DC.

Nick Reynolds is Research Fellow for Land Warfare at RUSI. Nick's research interests include land power, wargaming and simulation. Prior to joining RUSI, he worked for Constellis.

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Cover image: Ukrainian Mechanised Infantry riding a BMP, Ukraine, April 2023. *Courtesy of Jack Watling*

Royal United Services Institute
for Defence and Security Studies
Whitehall
London SW1A 2ET
United Kingdom
+44 (0)20 7747 2600
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