Australian Army
Research Centre

Spotlight Brief

No. 3, 2022

Tactical Observations on the 2022 Russian Invasion of Ukraine

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Tactical Observations on the 2022 Russian Invasion of Ukraine

Abstract

This Spotlight Brief examines Russia's combined-arms approach during its invasion of Ukraine in 2022. To provide context to this study, it discusses the primary Russian tactical unit of action, the Battalion Tactical Group. It subsequently explores a range of observations on the application of combined-arms at the tactical level during the initial phases of the invasion. It concludes by offering a number of deductions pertinent to the Australian Army's own application of combined-arms.

Introduction

Perhaps the first lesson of war is to learn the right lessons. Unlike other professions which practice their craft continuously, the experience of war for the soldier is intermittent. Therefore, soldiers, and armies, must look to contemporary conflict to understand what lessons these may offer in order to best prepare for the future.[1] Since the start of the Russian invasion of Ukraine on 24 February 2022, there has been much discussion on its conduct and what lessons may be drawn from it, particularly in regard to the application of combined-arms at the tactical level. However, there are inherent difficulties in observing an ongoing conflict from afar which make it easy to oversimplify or distort events in recent history. This risks drawing premature and speculative conclusions. Thus, for the Australian Army, careful study of the conflict in Ukraine is necessary to help it remain at the forefront of change and maintain a competitive advantage as it prepares for future war.

This article is the third in a series which examines the ongoing Russo-Ukrainian War. The first examined Ukraine's strategic circumstances in order to provide historical context to the conflict. The second provided an operational overview of the conflict's initial phases from February through June 2022. With the available open-source information, this article makes a number of observations on the Russian tactical application of combined-arms in Ukraine during the early phases of the invasion. To provide context to these, it first examines the construct and force generation of Russian tactical formations and units, focusing on the Battalion Tactical Group. It subsequently explores five combined-arms aspects, covering: Command and Control, Armour and Infantry, Artillery, Air-Land integration and Sustainment.

Russian Tactical Formations and Units

As per previous Spotlight Briefs, to provide context to the subsequent analysis, this study begins with a brief examination of the construct and approaches of the major tactical formations and units of the Russian Ground Forces. Since 2008, the Russian Armed Forces have attempted to transition away from a hollow force based on large-scale formations. These formations, led by cadres of 'contracted' or regular professional elements, would 'fill-out' by the mobilisation of large numbers of conscripts and reserves in time of war. Under the Serdyukov or 'New Look' reforms, the force oriented towards smaller formations with permanent ready-to-deploy elements. Consequently, most corps and divisional formations were converted into high readiness combined-arms brigades. It was intended that these were rapidly deployable and independently employable. These brigades combined contracted personnel and short-term conscripts, therefore relying less upon mobilisation. Between its Ground Forces, Airborne Troops, Naval Infantry and Spetsnaz, Russia could muster around 60 of these combined-arms combat brigades. While Airborne, Naval Infantry and Spetsnaz brigades field light mechanised forces, the Ground Forces field two types of heavier brigades: Tank and Motorized Rifle.[2]

A typical Motorized Rifle Brigade (MRB) consists of around 4,000 personnel, and is primarily comprised of armour, infantry, artillery and air defence elements. Its major combat units include a tank battalion and three motorized rifle infantry battalions. Of the latter, one is generally equipped with infantry fighting vehicles (IFV) and two with armoured personnel carriers (APC). The brigade's indirect firepower is provided by two self-propelled howitzer (SPH) artillery battalions and a multiple rocket launcher (MRL) battalion. The importance of air defence is illustrated by the inclusion of two battalions of mobile anti-aircraft systems, one based on surface-to-air missiles (SAM) and the other incorporating self-propelled air defence systems (SPADS) and man-portable air defence systems (MANPADS). The brigade also includes anti-tank, reconnaissance, engineer, signals and logistic support units and sub-units to enable a wide range of operations. In comparison, a Tank Brigade has up to three Tank Battalions and one IFV based Motorized Rifle Battalion with similar support elements to the MRB. While an entire brigade may be deployed to a theatre of operation, the means it actually fights with, or indeed may contribute to another force, is the Battalion Tactical Group (BTG). Each brigade reportedly has the ability to generate at least two BTG.[3] An example of a Motorized Rifle Brigade is shown in Figure 1.

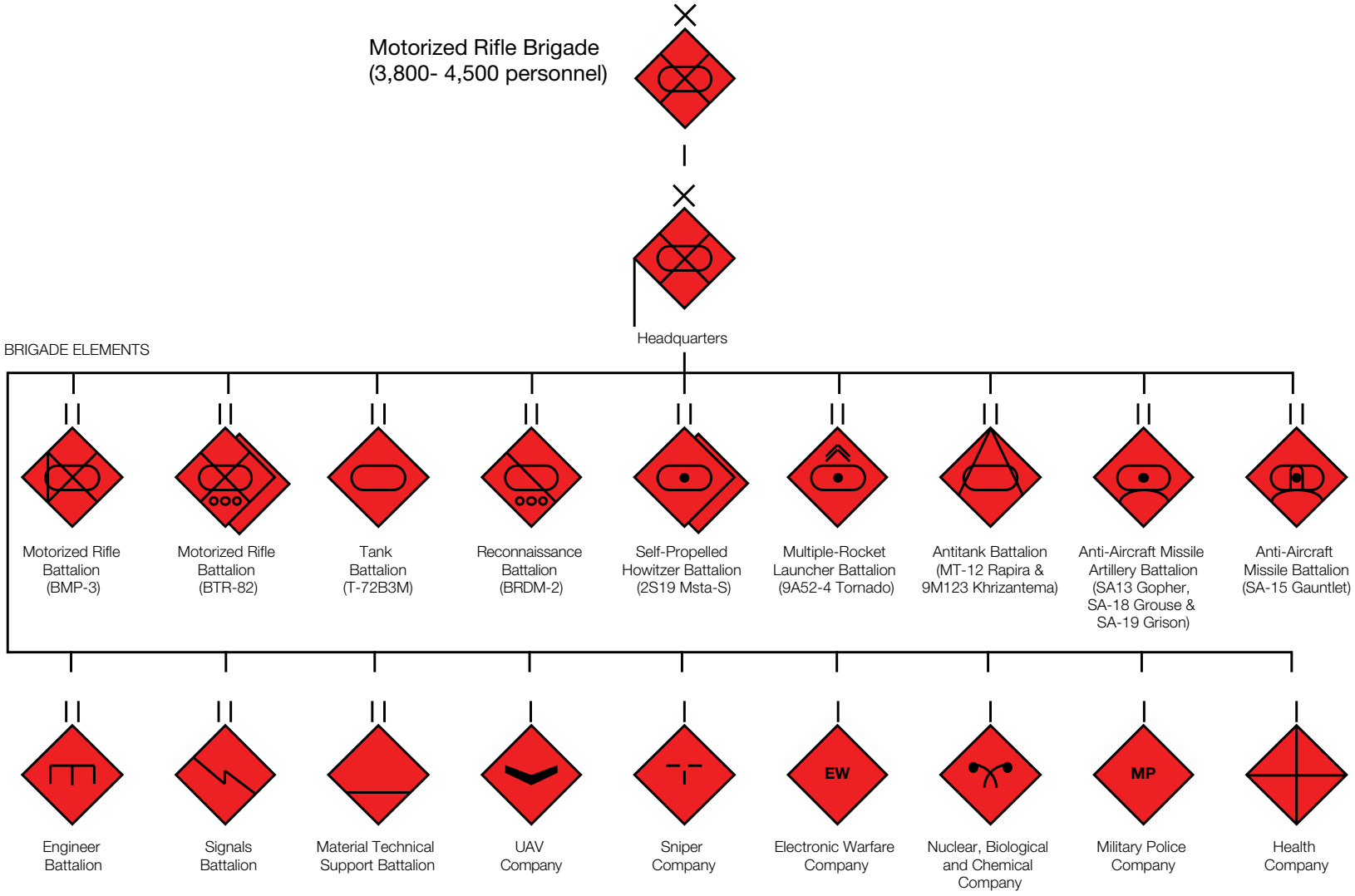

Figure 1. Motorized Rifle Brigade Organisation.[4]

The Battalion Tactical Group

Combined-arms battalion sized organisations are not a new concept for Russia. In the Soviet era, combined-arms units were improvised within formations by combining armour, infantry and artillery elements on a short-term basis.[5] The BTG approach was introduced in the 1980s during the Soviet-Afghan War, and aimed to provide better combined-arms effects by grouping armour, infantry, and artillery arms into one unit permanently. While this ostensibly meant that these elements could train together to provide mutual support, rather than occasionally practice together on field exercises, it created other issues. This approach required experienced, well-educated, and trained commanders and staff to implement combined-arms training and methods, as well as to manage supply and maintenance requirements. However, the dissolution of the Soviet Union, compounded by various conflicts over the 1990s and 2000s, meant that this approach was never fully realised nor the issues with it resolved.[6] The BTG was recast in the late 2000s. This iteration aimed to address the particular problems of hollowness in brigades and shortfalls of skilled soldiers which manifested in the readiness and performance of the Russian military during the Georgian War of 2008.

The typical contemporary BTG is based on either a Motorized Rifle or Tank Battalion. In Russian parlance, any infantry equipped with vehicles are referred to as 'Motorized Rifles'. These may be equipped with armoured personnel carriers (APCs) such as the wheeled BTR or tracked MT-LB, or tracked infantry fighting vehicles (IFVs) such as the BMP series. Given the significant differences in capability between APCs and IFVs, fighting approaches differ between these units, as do the tasks they are expected to perform. Motorized Rifle Battalions contain three Motorized Rifle Companies which are supported by a self-propelled Mortar Company and Grenade Launcher, Signal, Medical and Support Platoons. In comparison, Tank Battalions lack the organic fire support assets that Motorized Rifles Battalions have. Tank units are equipped with T-72B3M, T-80BVM or T-90M series main battle tanks (MBT). Notably, Tank Battalions in MRB may include a fourth company.[7]

Under the BTG approach, these battalions form the basis of combined-arms manoeuvre units. However, in contrast to Australian battle grouping practices, when formed as BTG, companies are not cross-attached between Motorized Rifle and Tank Battalions. Rather, in a manner similar to battalion grouping, sub-units of Tank Battalions are attached to Motorized Rifle Battalions often without the allocation of a Motorized Infantry Company to the Tank Battalion in return.[8] Another major difference is the direct attachment to the BTG of a large number of fire support assets, including batteries of SPH and MRL. Theoretically, this direct attachment facilitates rapid coordination between armour, infantry and artillery fire support, as well as weighting of fire support to priority missions. Furthermore, this combined-arms armour, infantry and artillery base is augmented by reconnaissance, anti-tank, air defence, unmanned aerial vehicles (UAV), engineer and electronic warfare (EW) elements attached from the brigade. The specific mixture and duration of the grouping is dependent on the mission allocated. However, in general terms, a BTG is an *ad hoc* self-contained combined-arms unit, formed to perform a specific mission or task, based on a Motorised Rifle or Tank Battalion with support attached from its parent brigade. It may be employed as part of that brigade or detached from it. Doctrinally, BTGs range in size from 700-900 personnel subject to the elements allocated to it.[9]

Importantly, the latest iteration of the BTG is not just a grouping of combined-arms. The BTG is a method to generate higher readiness units with better trained troops able to respond at shorter notice to the contingencies faced by Russia. However, around a third of Russia's Ground Forces are conscripts which poses challenges to this intent. Compulsory service only lasts for 12 months, of which a portion is absorbed by in-unit basic military training followed by more specific, on-the job training. This results in only a small window where conscript soldiers are employable by units. Further, unless they volunteer, conscripts are prevented by law from serving in operations abroad *except* when a war has formally been declared. As a result, units generally separate contracted soldiers and conscripts.[10]

This poses significant challenges to the deployment of complete units abroad. Given that BTG are created as a detachable and deployable instrument of the brigade, they typically draw upon the professional contract soldiers. However, short-falls in contracted personnel result in BTG drawing upon individual specialist contract soldiers, or at best, entire sub-units of disparate capabilities, e.g., tanks, motorized rifle and artillery, from multiple battalions across a brigade. This limits a brigade to realistically forming or 'force generating' only two BTGs in a formation, with conscript elements relegated to form a third 'non-deployable' pool of troops. However, when sufficient regular elements are not available due to shortfalls in personnel or equipment, elements are drawn from outside the brigade, posing further challenges. Therefore, while the BTG approach has the potential to form highly potent organisations, it also suffers from policies which impact upon its ability to physically conduct combined-arms warfare. An example BTG is shown in Figure 2.

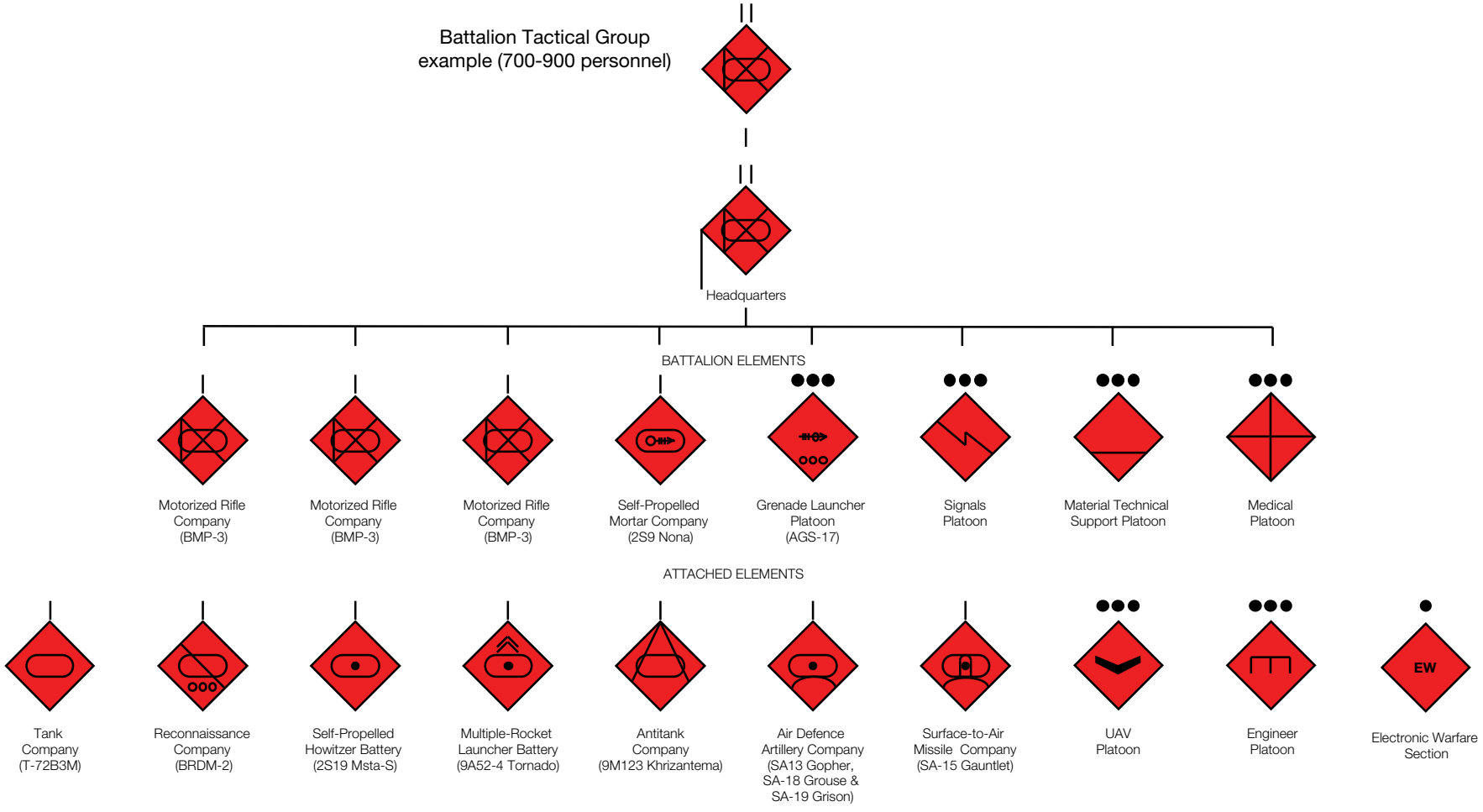

Figure 2. Exemplar Battalion Tactical Group Organisation.[11]

Combined-Arms Observations

The following sections discuss a range of observations on the application of combined-arms at the tactical level. These cover the following aspects: Command, Control and Communications, Armour and Infantry, Artillery, Air-Land integration and Sustainment. Importantly, these observations are not exhaustive due to the information available in open-source reporting. Nor do they cover all of the elements of combined-arms organisations or all aspects of the respective approach. Further, the period examined is limited to the initial phases of the Russian invasion of Ukraine from February through to August. Over time, more information will become available to enhance this study.

Combined-arms is an approach to warfare which integrates and synchronises the different combat arms of the military to achieve mutually complementary effects. A combined-arms approach maximises the effectiveness and survivability of these arms by employing them together. When these arms are employed in concert, the sum of their different effects generates multiple ways to target an enemy's weaknesses, as well as multiple ways to protect the vulnerabilities of friendly forces. A combined-arms approach targets the enemy with two or more arms *simultaneously*, such that the action taken by the enemy to defend from one arm makes them vulnerable to another. Conversely, a single-arms or supporting-arms approach employs each arm *sequentially*, or, if used simultaneously these arms provide the same effects, resulting in actions taken by an enemy to defend from one arm also countering the effects from others.[12] Importantly, the practice of combined-arms warfare is founded on effective command, control and communications (C3).

Command, Control and Communications

C3 is exercised by commanders, their staffs and subordinate elements during the planning and execution of military operations. Importantly, the Russian approach to planning and employment of tactical level organisations is reliant on commanders determining the 'solution' from a limited number of prescribed tactics. Staff convert this decision into orders based on planning figures, capability tables and established procedures – the 'science' of war. Planning relies upon well-rehearsed drills rather than development of a plan customised to the mission – the 'art' of war. Russian drills and

tactics, techniques and procedures (TTP) are simple yet rigid and, when universally applied by tactical units operating in concert they can quickly generate tactical mass. While this approach enables centralised control and concurrency of activity, this methodology sacrifices creativity in planning for speed in execution. It affords limited flexibility to commanders to deviate from pre-determined plans, particularly in the face of dynamic combat situations.[13] Analysis indicates that weaknesses in this approach were exposed during the initial period of the invasion.

Close study reveals that Russian planning for the invasion was impacted by the timing of the decision to invade. Various sources note that the Kremlin's decision to invade was 'last minute' and kept secret from all but a handful of people until days, if not hours, before the invasion.[14] The timing of the decision left little time for headquarters to coordinate forces and disseminate information across the breadth and depth of the force. Others note that there were significant failures in Russian intelligence, which failed to account for the improvement in the Ukrainian military since the commencement of the war in 2014.[15] As a result, this led to erroneous planning assumptions regarding Ukrainian will, capacity and capability to fight, producing overly optimistic timelines for the invasion. These factors created a number of issues at the tactical level.

Dr Jack Watling of the *Royal United Services Institute* (RUSI) identified that some Russian Motor Rifle and Rosgvardiya (National Guard) units received orders less than 24 hours prior to the invasion.[16] In one respect, it is a testament to Russian planning and drills that a large force was able to even mount an invasion on such short notice. However, as events unfolded, it became clear that the time available was inadequate to prepare the force for action. Time was insufficient for elements to conduct reconnaissance, establish flank and rear security, clear routes, pre-position supplies and conduct secure movement under the cover of air defences.[17] Russian forces showed little ability to operate per their combined-arms doctrine, with one U.S Defense official observing that "They [Russian forces] don't appear to be integrating their combined arms capabilities to the degree that you would think they would do for an operation of this size and scale and complexity."[18]

Similarly, the impact of optimistic assumptions about Ukrainian capabilities was demonstrated in the early fighting around the capital of Kyiv. Stronger than anticipated resistance, combined with reduced off-road movement due to an earlier than usual winter thaw, upset Russian planning schedules.

This slowed movement to a crawl, and as roads became congested with troops, movement stopped completely. This not only hindered the deployment of combat power forward, such as artillery, but also constrained the ability to conduct resupply. Emblematic of this, only days after the invasion commenced, a 64-kilometre long convoy stalled north of Kyiv where it remained for weeks. Vehicles carrying fuel, munitions, repair parts, food and other supplies were unable to deliver them to forward units. As a result, combat elements ran out of ammunition, fuel and food, resulting in troops unable to fight and others abandoning their vehicles and equipment.[19] Conversely, other Russian elements met little resistance and raced ahead of their formations, with some becoming isolated from their support. A number of these were then cut-off and destroyed. Therefore, the limited time available prior to the invasion coupled with planning based on flawed intelligence, contributed to the lack of preparedness and poor coordination of Russian forces at the outset of the invasion.

Another factor contributing to weaknesses in Russian C3 was the ad hoc approach taken to force generate BTGs. The *Institute for the Study of War* identified that the Russians generally did not deploy entire formations into Ukraine during the invasion.[20] As the invasion was classed as a 'special military operation' – and not a declared war – brigades were deployed without their conscript elements. Analysis indicates that elements of almost every single brigade of the Russian Ground Forces, Airborne Troops and Naval Infantry dispatched elements to Ukraine. Consequently, this meant that a BTG might not only draw upon elements from its parent brigade, but elements from other brigades, other combined-arms armies, other military districts or even other services spread across Russia.[21] This ad hoc approach to generate combat units posed several major issues for C3 at the tactical level.

A key issue impacted by this approach was unit cohesion. The combat power of brigades and BTGs is a product of the ability of the units and sub-units within them to operate as cohesive entities. Importantly, cohesion requires both individual and collective competence. Individual competence is developed through training and supervision, a role undertaken by non-commissioned officers (NCOs) in Western militaries. However, the Russian approach is markedly different. Given the conscript nature of its enlisted ranks, there is no equivalent NCO career pathway in the Russian Ground Forces. As a result, Russian junior officers predominantly perform many

of the duties that NCOs in Western militaries do.[22] While the number of contracted enlisted soldiers becoming NCOs has increased in recent years, there is a significant deficit in this capability. This manifests in a lack of junior leaders able to conduct and supervise training and execute low-level tactics and command in battle. Furthermore, it takes significant time during force generation for even well-trained professional soldiers to develop and practice the TTP to achieve the cohesion necessary to fight together. While elements of the Russian force did exhibit high standards of individual training and many elements had spent significant time on exercises prior to the invasion, cobbling together units immediately prior to the operation likely negated many of the benefits of this collective training. Therefore, the combination of too few junior leaders to supervise individual training and inadequate collective training, likely contributed to poor cohesion, which in turn undermined tactical level C3.

Another failing of this ad hoc force generation is the technological aspect of C3. When BTG are drawn from multiple formations, even units of supposedly the same capability, e.g., Tank or Motorized Rifle Battalions, encounter difficulties with equipment compatibility. The wide variety of types, models and ages of C3 equipment in service, such as radios and battle management systems, meant that organisations suffered compatibility and range issues due to differences in equipment, which affected their ability to communicate. This was compounded by the destruction of Ukrainian mobile phone towers which severely degraded the ability for the Russian *Era* secure battlefield phone network to operate. As a result troops resorted to unencrypted radios and mobile phones, exposing these communications to interception and monitoring.[23] Ukraine was then able to target Russian C3, including strikes upon headquarters nodes and electronic attacks on communications networks. This was combined with the denial of airspace to airborne C2 assets and the targeting of Russian leaders who travelled to the frontlines to command their forces.[24] Consequently, compatibility issues and efforts by Ukraine to attack C3 systems, hindered Russian efforts to communicate orders, maintain situational awareness, control troop movement and conduct routine administration.

Five deductions are drawn from these observations. First, future conflict may occur with little, if any, prior warning. This could reduce or even negate the time available to plan and prepare both physically and psychologically for war. Therefore, individual and collective readiness measures should reflect

changes in strategic warning time. Second, C3 systems need to be compatible force wide to enable interoperability between units when employed across multiple formations. Third, to achieve cohesion, combined-arms organisations must train how they intend to fight. When Australian unit and sub-unit level organisations form task-organised battle groups and combat teams, either in training or operationally, they require adequate time prior to deploying to generate or 'create' the team that will execute the combined-arms approach. This includes universal understanding of TTP and standard operating procedures as well as prolonged field training to achieve integration. Fourth, training should include the ability to operate with alternate means in an environment where C3 systems, such as combat net radios, battle management systems and navigation aids such as global positioning systems (GPS), are degraded or denied. Fifth, and complementing the above deduction, ground forces should seek to reduce their signature in the electro-magnetic spectrum. This includes tightening communications security to reduce open-source intelligence data mining via social media, mobile phones and email.

Figure 3. Russian convoy destroyed in the city of Bucha (source: MilitaryImages.net).[25]

Armour and Infantry

Both Russian and Ukrainian forces have extensively employed armoured fighting vehicles (AFV) within armour and infantry manoeuvre units during the war. These include MBT, IFV and APC as well as reconnaissance and engineering vehicles. This employment has been across a wide range of offensive and defensive operations, in open and close terrain as well as in and around cities. Accordingly, as these forces have shouldered the vast bulk of combat during the invasion, they have also endured significant losses. These are discussed in greater detail under the Sustainment section of this paper, however; it is important to note that Russian AFV losses have been significantly greater than Ukraine's. A number of reasons for this are examined below.

A key factor which may have contributed to these losses is poor infantry-to-armour ratios within BTGs. One observer posits that, based on information obtained through captured Russian documentation, the numbers of infantry personnel in Russian Motorized Rifle Battalions has been drastically reduced due to changes in force structure.[26] This has resulted in platoons comprised of just 22 soldiers to populate a headquarters and three squads. If a seven-man squad includes the vehicle crew, the number of infantry available to dismount and fight on foot is reduced to just four soldiers. This greatly affects the type and number of tasks that these troops can perform as well as the physical terrain which they can cover.

Analysis of fighting in the urban periphery and core of major cities during the initial weeks of the invasion indicates that the paucity of infantry may have resulted in poor integration between armour and infantry elements. As Russian forces advanced towards and into cities such as Kyiv, Sumy, Chernihiv and Kharkiv, the requirement for close mutual support between armour and infantry forces increased. In urban confines, the vulnerabilities of AFV to close range anti-armour weapons becomes acute as they cannot employ their sensors and weapons systems at maximum range. This reduces their situational awareness, presenting enemy forces greater opportunities to close with them and employ anti-armour weapons against weaker flank and rear armour. Conversely, infantry fighting on foot are vulnerable when faced by an entrenched or fortified enemy. As they lack the physical protection to move across fire-swept ground they are easily killed. They have insufficient firepower to penetrate buildings or fortifications easily and can quickly expend their ammunition in sustained close combat.

Furthermore, they can quickly become exhausted when fighting in urban terrain which has been reduced to rubble.[27] Therefore to protect these vulnerabilities the close integration of armour and infantry is key.

Infantry-armour integration manifests through mutual support. Infantry provide AFVs intimate protection by clearing defiles, identifying mines and improvised explosive devices, providing early warning against ambushes and clearing anti-armour systems. Armour in return provides intimate support in the form of immediate direct fire support, physical protection by shielding them from enemy fire, by coordinating indirect fire support, and; by rapidly resupplying ammunition and carrying additional weapons and equipment. Thus, the paucity of infantry in Russian BTG may have severely inhibited their ability to clear and hold terrain, neutralise artillery observers and trigger ambushes, thereby exposing the vulnerabilities of accompanying AFV to attack, particularly to short-range anti-armour systems.

Figure 4. Russian T-90 tank and BMP-3 IFV (source: MilitaryImages.net).[28]

Another factor of note was the interplay between armour and anti-armour technology. During the opening phases of the invasion, Ukrainian forces demonstrated the vulnerability of Russia's legacy armoured vehicles to late generation anti-armour weapons. This was particularly evident in the

defence of Ukraine's cities where anti-armour systems were employed at favourable ranges and firing positions. Roving teams of light infantry, well-stocked with anti-armour weapons were effective in disrupting the efforts of armour and infantry forces to encircle Kyiv, as well as the defence of Sumy and Chernihiv oblasts.[29] These efforts were underwritten by the supply of tens of thousands of modern anti-armour weapons. Donated anti-tank guided missiles (ATGM), such as the FGM-148 Javelin and RB-57 Next Generation Light Anti-Tank Weapon, complemented Ukraine's stocks of the Stugna-P and hand-held anti-armour rockets [30] Modern ATGM typically feature tandem warheads to defeat complex armour arrays, thermal imaging sensors and the ability to lock on to a target before launching. This enables the missile to automatically guide itself to its target, commonly referred to as 'fire-and-forget' targeting. These systems proved highly effective against much older Russian armour.

Soviet-era tanks, including the T-62 (1961), T-64 (1966), T-72 (1972), T-80 (1976) and T-90 (1991), were designed to address threats from an earlier era. These tanks were mass produced to defeat NATO tanks during the Cold War, long before modern ATGM were developed. Given their age, their designs logically have weaknesses against more modern systems. These include the arrayment of armour predominantly across a narrow frontal arc, leaving the top, flanks, and rear of the vehicle less protected. Likewise, these designs do not store their ammunition separate from the compartment where the crew reside. Western MBT, such as the US M1 Abrams, store ammunition in separate magazines, thereby improving the chances of crew survival if the vehicle is penetrated and its ammunition detonates. However, Soviet-era tanks were not designed with this safety mechanism and are more prone to the 'jack in the box' effect in which the tank's turret is violently separated from the hull when its ammunition detonates.[31] Furthermore, Russian armour deployed to Ukraine appears to have made little use of active and passive protection systems, placing them at even greater disadvantage. These include hard and soft kill systems, acoustic shot detectors and laser warning receivers. Active protection is particularly important to defeat ATGM such as those previously mentioned. Therefore, given the almost complete absence of Russian MBT equipped with modern protection systems, it is unsurprising that vehicle technology dating back to the 1960s has proven vulnerable to anti-armour weapons designed many decades later.

The RAND Corporation's David E. Johnson summarised Russian armour and infantry performance during the early stages of the invasion;

> *'The Russian Army has shown that it is not competent in combined arms fire and maneuver. Where is the accompanying infantry with the tank formations, who are supposed to bust the ambushes executed by Ukrainian forces? Where are the suppressive mortar, artillery, and close air support fires? If the Russian Army was tactically skilled, then the Javelin and other ATGMs would be suppressed by artillery or air support and their surviving crews would be swept up by Russian infantry. Thus far, these key competencies seem to be lacking and Russian soldiers are paying a high price for their unpreparedness.*[32]

Thus, while it may be tempting for commentators to sound the death knell of the tank and Armour more generally, given the causal factors illustrated this is simply incorrect. Russia's poor application of combined-arms warfare, particular infantry and armour integration, and grossly out dated AFV, exposed the vulnerabilities of both arms to an effective Ukrainian defence. This should not be misconstrued that Armour or combined-arms warfare is irrelevant or obsolete, rather that when applied poorly against modern threat systems, these systems will exact a punishing toll.

Four deductions are drawn from this analysis. First, both sides have extensively employed AFVs during the war, highlighting that these capabilities remain important in contemporary conflict. This is likely to remain the case while the inherent characteristics of AFVs – firepower, mobility and protection – are needed to destroy enemy forces and to seize and hold ground. Second, the war has illustrated the danger of employing dated AFV designs lacking protection against modern anti-armour systems. In the 21st Century, modern AFV equipped with a balance of advanced armour arrays and active and passive protection systems are necessary to survive contemporary anti-armour threats and succeed in close combat. Third, for both to be effective, infantry and armour must be employed in appropriate ratios. Without sufficient infantry elements available at the time and place needed, the inherent vulnerabilities of armour are exposed. Likewise, infantry need armour to provide direct fire support, battlefield mobility and protection. Fourth, these combatants must routinely train together to form the habitual relationships necessary to mutually support each other in close combat. Absent this, the ability for armour-infantry teams to employ effective TTP is greatly eroded.

Artillery

Russian Ground Forces place a primacy on artillery. Due to this, the Russian approach to the employment of artillery differs markedly from Western philosophies. In Russian practice, armour and infantry support artillery fires, while Western thinking aims to synchronise artillery fires in support of armour and infantry. This philosophy is executed via two approaches. At the strategic-operational level of war, Russia employs a *Reconnaissance Strike System* methodology. This combines strategic intelligence, surveillance and reconnaissance (ISR), cyber and geo-locating technology with long-range surface-to-surface missile systems and aerial delivered precision guided munitions (PGM) to strike through the depth of an enemy force. The *Reconnaissance Fire System* is the operational-tactical equivalent and links data from ISR assets, such as UAV, targeting processes and artillery control centres to engage high-value targets in near real-time, using conventional and precision munitions from mortars, cannon and rocket artillery. Both approaches favour volume and intensity of fire over accuracy and accept the high likelihood of civilian casualties when targeting cities. Massed fires provide mathematical certainty of consumption rates for desired effects on given targets, which aligns with Russian planning approaches. [33]

In order to achieve effects at tactical-operational levels, BTG are allocated significant artillery assets from their parent brigade. These include SPH and MRL batteries to augment their integral mortars. In application, armour and infantry elements are first employed to secure ground that enables artillery fires to be employed against enemy forces. Armour and infantry then envelope an objective, such as an enemy strong point or population centre, in order to lay it to siege. This enables artillery elements to bombard the objective until they capitulate or are weak enough for these elements to be committed to close with and destroy the remaining enemy forces, and seize and hold ground in anticipation of the cycle repeating.[34]

This philosophy is reflected in the Russian employment of artillery in Ukraine. The initial Russian advance toward Kyiv was spearheaded by ground and airborne forces aiming to envelop the city. Trailing these thrusts were long columns of artillery which would have provided the firepower to threaten the capital. However, these thrusts suffered significant reverses which prevented Kyiv from being encircled. Equally, due to congestion on the limited axes of approach to Kyiv, Russian artillery was often physically dislocated from armour and infantry elements which had advanced beyond their support.

This exposed these elements to Ukrainian anti-armour weapons which were not supressed by artillery support. Consequently, these forces had significant difficulty in advancing and seizing ground and suffered heavy casualties in doing so, ultimately resulting in the withdrawal of forces from around Kyiv. Concurrently, Russian forces advancing into eastern Ukraine laid siege to a number of cities, including Sumy, Chernihiv and Kharkiv in the north-east, and Mariupol in the south. However, these sieges suffered from a lack of armour and infantry elements to complete the encirclement of these cities and then assault them. Direct attacks proved ineffective resulting in artillery, rockets, cruise and ballistic missiles strikes to saturate Ukrainian defences. While the siege of Mariupol ultimately proved successful, the city itself was devastated.

In later phases, Russia prioritised artillery strikes over ground manoeuvre during the fighting in the Donbas region in the east of Ukraine. Massed fires enabled a slower but more methodical approach, steadily reducing the defences of the cities of Sievierodonetsk and Lysychansk over the course of June-July. Given the quantitative advantage it enjoys over Ukraine, Russia likely employed at least three times the amount of artillery to achieve fire dominance in these battles. The increased use of artillery potentially stems from the high casualties among Russian armour and infantry elements. Equally, the desire to reduce further casualties, such as experienced during the First Chechen War of 1994-95, probably drove the increased use of artillery to attrite Ukrainian defenders in these cities.

This approach has attracted criticism from Western observers. Seth Jones, Director of the International Security Program at the *Centre for Strategic & International Studies*, argued that combined-arms failures led to the Russians resorting to bombarding cities, towns and villages in an attritionalist approach.[35] Likewise, retired Army General David Petraeus noted that when Russian forces 'confront a particularly determined and skilful urban defense, they pound it with artillery, rockets, missiles, and bombs until it is totally destroyed and 'depopulated'.[36] This criticism is supported by the destruction of significant parts of Kharkiv, Sievierodonetsk and Lysychansk and the complete devastation of Mariupol, labelled as an act of 'almost no military utility'.[37] Paradoxically, Russian bombardments have also resulted in large numbers of civilian casualties amongst ethnic Russians in regions which Russia aims to incorporate. This approach contrasts starkly with Western approaches to modern military campaigns where the preservation of civilian life and infrastructure has been a dominant feature in operations within cities.

Others have also noted that since April 2022, tactical commanders have generally centralised artillery control. Brigades have retained control over most assets, forming *artillery tactical groups* rather than allocating them directly to BTG. This has concentrated artillery firepower to more readily target and destroy Ukrainian forces assembling in any size greater than a company, thereby limiting their ability to mount counterattacks across the Donbas. As a result, Russian artillery has frequently operated independently from armour and infantry, with less emphasis on missions in support of them in this phase of the war.[38] However, this has also resulted in requests for fire support from these elements passing through a convoluted chain of command for approval, resulting in long delays in fire support missions to armour and infantry elements.[39] Russian media and military bloggers noted that these delays ranged from several hours to several days.[40]

Three deductions are derived from this analysis. First, the war in Ukraine has reinforced a costly lesson from 20th Century wars, regardless of whether it is employed as massed barrages or in precision strikes, artillery fire alone is not enough to defeat an enemy. Ground manoeuvre forces are necessary to achieve decision as artillery cannot guarantee that an enemy will capitulate. Equally, manoeuvre without adequate fire support has proven very costly. Therefore, the combination of armour, infantry and artillery in well-led, well-trained and well-supported combined-arms teams remains the *sine qua non* for success in ground combat.

Second, the Russian attritional approach of employing artillery to destroy cities is neither militarily productive nor aligned with Australian war fighting philosophies. In an Australian context, future combat in and around cities will require the employment of armour, infantry and artillery in concert with other arms to ensure fires are applied with precision, accuracy and discrimination. This will require artillery observers/joint fire teams to be located in close proximity to the point of contact between the enemy and own forces to enable the most accurate employment of fire support. Observers, therefore must have the ability to operate in this zone.

Third, the concept of striking through the depth of an enemy as discussed under the Russian Reconnaissance Strike and Fires systems may be useful to inform Australian approaches. As Army acquires more capable artillery systems such as SPH, MRL, precision strike missiles and potentially long-range anti-ship missile systems, it will be able to engage targets across the enemy's operational, if not strategic, breadth and depth. Army's operating

approaches may require revision to determine how these systems are employed to conduct deep strike and how ISR assets such as cavalry, UAV, and aviation may best enable them to do so with target data.

Figure 5. Russian BM-30 Smerch Multiple Rocket Launcher (source: MilitaryImages.net).[41]

Air-Land Integration

Air-Land integration is an approach which seeks to maximise military power by coordinating and synchronising complementary capabilities from air and land domains. Air power can enable land power by assisting freedom of manoeuvre, by air strikes and enhancing mobility. Conversely, land power enables air power by securing air bases, lines-of communication, target identification/designation and by suppressing enemy air defences.[42] Key capabilities which contribute to air-land integration include aircraft, helicopters and UAV, air bases, ground based air defence (GBAD), command and control (C2) networks, radars, counter rocket, artillery and mortar sensors and warning systems, among others. This next section explores some aspects of air-land integration, focusing on the failure to achieve air superiority in the first days of the invasion as well as the employment of UAV and GBAD.

Air superiority is often considered an essential precondition for success in modern war, particularly in Western military thinking. Air superiority provides the ability for air operations to be conducted at the time and place of choice, without interference by adversary air power and air defence capabilities.[43] Given this definition, it is evident that neither side has managed to establish air superiority over Ukraine since the invasion commenced. The airspace above Ukraine remains highly contested, with both forces suffering considerable losses of aircraft and ongoing strikes against each other's troops, airbases and installations.[44] Consequently, the inability to achieve control of the air has impacted the application of both air and land power.

At the commencement of the invasion, the Russian Aerospace Forces enjoyed qualitative and quantitative advantages over the Ukraine Air Force. It had hundreds of advanced fighters, ground attack aircraft, long range bombers as well as airborne early warning and ISR assets. These capabilities were complemented by cyber and electronic warfare systems, as well as cruise and ballistic missile strikes. Large numbers of missiles strikes were launched in the early hours of the invasion targeting Ukrainian C3 infrastructure, early warning radars and GBAD. While these blinded and blunted Ukrainian air defences temporarily, these failed to neutralise the Ukrainian air defence network, nor prevent air bases from operating or destroy Ukraine's aircraft whilst on the ground.[45] Equally, Russia was unable to identify and destroy Ukraine's mobile SAMs, SPADS and MANPADS. Mobile GBAD systems proved much more difficult to target from the air than fixed systems, requiring more assets to detect and identify them.[46] However, these systems were not neutralised and continued to pose a significant risk to Russian aircraft, a situation which has persisted throughout the war.

The Russian response to this risk was threefold. First, Russian sorties against Ukraine were severely restricted with most aircraft remaining on the ground during the early stages of the invasion. Second, the threat posed by Ukraine's early warning radars, electronic warfare systems and medium-range GBAD forced Russian aircraft to operate outside of Ukrainian airspace. Third, this led to a reliance on the use of long-range PGM fired from within Russian air space. While, the initial use of PGM was extensive as the war progressed the high rate of expenditure led to a reduction in the frequency of strikes and a reversion to 'dumb' bombs.[47] As a consequence of the shortage of PGM, Russian aircraft and helicopters were forced to fly at low levels and in close proximity to their targets to employ unguided munitions,

which then brought them into range of shoulder-launched, short-range, SAMs and MANPADS.[48] Thus, while Russia's response did reduce the risk to its aircraft, it also severely limited its ability to conduct sorties in support of its own ground forces. These included missions such as defensive counter air, close air support, ISR collection and air lift of ground forces. This was compounded by poor coordination between Ground and Aerospace force C2 elements. As a consequence of these factors, Russian ground combat forces were subsequently exposed to attacks from Ukrainian aircraft.

Russian GBAD also faced challenges. During the early stages of the invasion as Russian Tank and Motorized Rifle elements advanced they ran the risk of outpacing their BTG support elements. As mentioned, because of C3 failures, effective coordination between headquarters, GBAD and manoeuvre proved difficult. Without effective control of rates of unit movements and dispositions, combat forces ran the risk of straying outside the umbrella of protection provided by air defence elements. When this occurred, combat units were left exposed to Ukrainian attack helicopters, ground attack aircraft and UAV. Equally, GBAD capabilities that were not able to keep pace with the units that they were to support ran the risk of being left behind and falling prey to attack or ambush. Conversely, when GBAD and combat forces operated together, they were able to protect each other from both air and ground threats.[49] Therefore, the close coordination of GBAD with armour and infantry proved necessary to provide the freedom to manoeuvre beneath contested air space.

Figure 6. Russian SU-25 Frogfoot Ground Attack aircraft (source: MilitaryImages.net).[50]

This conflict has witnessed the widespread use of various types and tiers of UAV by both protagonists. Notably, both sides have employed armed UAV, although accurate numbers of casualties directly attributable to a particular UAV (or UAVs in general) remain elusive. Ukrainian use of UAV appeared to be most successful when exploiting the initial inability for Russian forces to achieve air superiority and weaknesses in their application of combined-arms

ground manoeuvre. In his examination of the war, the Deputy Director for Intelligence of the US 7th Air Force, Lieutenant Colonel Tyson Wetzel, noted that 'Russia appeared to have no plan for countering Ukrainian uncrewed aerial systems (UASs) and drones, and those systems took a devastating toll on Russian ground forces.'[51] While particular conditions prevailed, e.g., uncoordinated, inactive and scattered air defence and electronic warfare systems, UAVs such as the medium altitude long endurance TB2 *Bayraktar* appear to have been effective. These systems operating 'low' and 'slow' were successful in attacking dispersed ground forces as they advanced across Ukraine. However, as the invasion evolved, there is less evidence of successful strikes. Russian forces, generally static in the east and south of the country, adapted their organisations and TTP to defend against the threat of Ukrainian UAVs. Several sources argue that the thickening of short-range GBAD and greater use of radars resulted in a scaling back of the use of larger UAV. The limited stand-off range, speed and performance of these UAVs meant they were easily overmatched by more capable and better coordinated Russian air defences, which reduced their effectiveness.[52]

This conflict has also witnessed the employment of UAV across an increasing number of roles. In addition to the strike role, UAVs have been widely employed in traditional roles such as ISR, weapon locating, battle damage assessment, communication relays and electronic warfare. Small UAV have also been increasing employed in other applications. These include 'suicide' or 'kamikaze' type attacks by 'loitering' UAVs, and their use to lay anti-personnel mines and drop hand grenades into vehicles and bunkers. While purpose-built systems such as the *Switchblade* and *KUB-BLA* have been employed in these roles, by Ukraine and Russia respectively, commercial UAVs have also been employed in roles that could be described as a 'poor man's PGM'. These small UAVs have ranges beyond most anti-tank guided missiles and have a terminal attack speed well over 100 kilometres per hour. Given their size, they are also difficult to detect and shoot down and thus present a viable threat to ground forces. In response to this, Wetzel suggests that nations must examine and invest in counter-UAS technology, doctrine and tactics to specifically defeat these smaller systems.[53] This may include microwave emitters, radio frequency jammers, cyber-attack, lasers, small arms fire, armoured vehicle cannon, air defence artillery, surface-to-air missiles, helicopters, aircraft and other drones.

From this analysis four deductions are made. Against a peer threat, Russia, even with clear advantages in air power, failed to establish air superiority and was unable to provide effective air support to its ground forces. Thus, in potential future peer-on-peer conflict, Australian forces are unlikely to enjoy the freedom of action afforded by uncontested air space. Even setting the conditions for *air parity* may be difficult to achieve against a threat with late model aircraft, extensive air defence networks and resilient C3. This will impact the ability of air assets such as helicopters, fighter aircraft, UAV and air transport to provide close air support, airborne ISR, EW and C3 as well as air lift/resupply. Consequently, Army, and the Australian Defence Force more widely, must plan and be prepared to operate in a contested air environment.

Second, UAVs have cemented their utility and effectiveness in conflict. They have been highly effective across a multitude of tasks including ISR, target acquisition and strike. Army could expand its strike capability by acquiring armed UAVs to perform close air support and augment its aviation assets. These could be complemented by cheap, expendable loitering UAV. Ukraine has also highlighted that UAS are not invincible and that, like any capability, they have inherent weaknesses which make them vulnerable. Therefore, it is important that UAV are incorporated into combined-arms organisations and approaches at the lowest level practicable to ensure that these weaknesses are masked by the strengths of other systems, and ensure that counter-UAV planning becomes part of established practice.

Third, in response to the threat of air power, Army could also review its GBAD requirements including sensors, weaponry and C2 methods. Army is currently updating its short-range GBAD capability with the *National Advanced Surface to Air Missile System*, and its planned AFV fleet will gain additional close-in protection against UAV with programmable munitions. However, a gap may exist between these two systems that can be exploited by UAV. Therefore, Army could consider acquiring a mobile, protected *very short-range* GBAD system which can fill this gap. It could be capable of defeating small loitering UAV swarms and medium UAVs capable of stand-off strike. Fourth, as part of Army's contribution to air-land integration, it may need to examine its role in an Australian concept of *air denial*. Particularly, it could examine how it would employ its mobile air-defence systems within a broader integrated joint air defence system and how it could find and destroy an enemy's systems.

Sustainment

In Australian military parlance, sustainment is the provision of personnel, logistic and other support required to maintain operations or combat until successful accomplishment of the mission or the national objective. Successful sustainment enables the generation and maintenance of combat power to achieve the assigned mission. It encompasses *logistics*, the science of planning and carrying out the movement and maintenance of forces, and *combat service support* (CSS). CSS is logistics actions, processes, functions and services that are undertaken during delivery of support to a combat force or combat support force. CSS differs from logistics in that the focus is the provision of support *directly* to those forces engaging in combat. Consequently approaches, TTP and security requirements differ from logistics units which may *indirectly* support combat forces. This section will examine aspects relating to CSS, the impact of combat losses and supply support.

In terms of the Russian BTG, its only organic CSS element is the Support Platoon. It provides limited maintenance, recovery (vehicle salvage), transport, catering and shower/hygiene support. Other assets from the brigade Material Technical Support Battalion may also be attached to the BTG or provide support to it. In mobile operations the Support Platoon and these brigade elements provide the means to supply BTGs from static supply dumps and railheads via ground lines-of-communication. Throughout the initial phases of the conflict, Russian BTGs were initially serviced from railheads in Russia. As Russian forces penetrated deeper into Ukrainian territory aiming to encircle Kyiv, they encountered population centres along major road networks. Points of strength, such as the cities of Chernihiv and Sumy, were either bypassed or besieged by follow-on elements. This resulted in a non-contiguous and non-linear advance, with pockets of Ukrainian resistance left behind. Equally, these thrusts meant that Russian ground lines-of-communication extended each day that the force advanced further into Ukraine. This was exacerbated by the inability to employ the Ukrainian rail system, which in many areas in the east of the country been rendered non-functional.[54] As a result, Russian CSS and logistics elements were not protected by a continuous line of Russian forces, often leaving flanks and rear areas exposed. Furthermore, there was an escalating reliance on truck borne supplies travelling on ground lines-of communication.

As one observer noted, the interdiction of these ground lines-of-communication has 'become one of the defining features of the Ukrainian defense.'[55] The severing lines of supply to forward troops by irregular forces such as Territorial Defence units and civilian volunteers supported by Ukrainian Special Forces, had a disproportionate effect on the fighting abilities of front-line Russian combat troops. These irregular forces, either overtaken by the rapidity of the Russian advance or subsequently infiltrating past it, specifically targeted Russian resupply convoys bound for the forward-deployed combat troops. Given the reliance on trucks, Russian CSS convoys were easily anticipated as they were bound to roads and thus subject to a range of attacks including mines, improvised explosive devices, small arms and anti-armour ambushes, UAV delivered munitions and artillery strikes. The effects of this were twofold. First, this forced the diversion of Russian combat elements to provide rear area security, drawing on either the lead-forces advancing towards Kyiv or follow-on forces. Second, it disrupted the delivery of much needed CSS to the advancing forces, hindering, and in some cases stopping the flow of supplies, personnel and equipment. Further, as maintenance and repair workshops formed part of the Material Technical Support Battalion of their parent brigade, these did not accompany BTGs forward. Hence, major vehicle and equipment breakdowns were required to be transported rearward to enable repair. Interdiction or blocking rearward movement may have also contributed to the large quantities of abandoned vehicles noted earlier. By mid-March 2022 the attempt to seize Kyiv was abandoned and the North and North Eastern Fronts began to collapse (see Spotlight Brief 2-22 for a detailed overview of these fronts). While the disruption of Russian ground-lines of communication alone did not trigger this collapse, it was an important effort which helped set the conditions for it.

Another aspect of major importance is combat losses. The opening phases of the invasion witnessed the most intense mobile combat in Europe since the Second World War. While the second phase featured mostly static fighting, this has been no less taxing on both forces. Each has sustained significant losses across personnel, vehicles and equipment. Numbers of personnel casualties, to include military and civilian, are not well understood at this stage of the war. Official Ukrainian and Russian sources differ widely from each other with each seeking to maximise enemy losses and minimise numbers of friendly casualties. In an interview with US media outlet *Newsmax* in late May, Ukrainian President Volodymyr Zelenskyy provided

a rare insight into the impact of personnel losses, admitting that at that point in the war, 60-100 soldiers were dying daily with as many as 500 more injured.[56] Dr Alexey Muraviev, Associate Professor of National Security and Strategic Studies at Curtin University, argues that this is a 'staggering' casualty rate by Western standards, equating to the loss of a battalion a day or a brigade weekly. [57] In response to growing casualty rates, both forces undertook measures to rapidly bolster personnel numbers. Ukraine's 250,000 active and reserve soldiers have been reinforced with around 450,000 mobilised citizens. Russia initially sought to surge its force size by reinforcing from uncommitted elements of its armed forces, hiring foreign fighters, and increasing recruitment. In both cases, mobilisation suggests that both sides are preparing for a long war.

Vehicle losses have also been significant for both sides. While exact numbers are elusive (as are the causes) it is evident both forces have suffered large numbers of AFV casualties. The website Oryx is a useful source which tracks Russian and Ukrainian losses with photographic and video evidence. However, Oryx's is reliant on feeds from social media, which may result in inaccurate and incomplete numbers. It also does not identify the weapon that destroyed/damaged the vehicle, nor does it track the numbers of captured vehicles actually employed by either side. Accepting these limitations, it is clear that Russian AFV losses (which include destroyed, damaged, captured and abandoned vehicles) are much higher than Ukrainian AFV losses, as shown below.

Table 1. Reported Russian and Ukrainian Armoured Vehicle Losses from Oryx.[58]

Combatant	MBT	IFV	APC	AFV (other)	Total
Ukraine losses	266	233	107	137	743
Russian losses	1,155	1,280	162	601	3,198
% Ukr-Ru	23%	18%	66%	23%	23%

In broad terms, this data illustrates that the ratio of Ukrainian to Russian vehicle losses is around 23% or 1:5. However, this does not account for the total numbers of vehicle losses as a percentage of total vehicle holdings in each force. According to the *Military Balance 2022*, Russia had 2,927 MBT, 5,180 IFV and more than 6,000 APC in its active force inventory.
By comparison, Ukrainian operational AFV prior to the invasion were

assessed as only 858 MBT, 1,212 IFV and 622 APC, illustrating the disparity between the size of the two forces.[59] Furthermore, pre-invasion Russian reserve stocks of AFV were assessed at 10,000 MBT, 8,500 IFV and 4,000 APC. In comparison, Ukraine had in storage 1,132 MBT, again highlighting the stark differences in the depth of equipment reserves between the two sides.[60] Therefore, when considering the raw numbers of vehicle stocks held, Russia is theoretically more likely to both sustain and replace vehicle losses quickly. However, this is caveated by the fact these replacements may be earlier models and the assumption that these can be brought into service without excessive maintenance. Evincing this, Russia began to draw aged T-62 tanks out of storage as early as May. In contrast, Ukrainian losses have largely been replaced by the transfer of several hundred T-72 tanks from neighbouring Poland, alongside significant donations of SPH, MRL, towed artillery and other military aid from Western countries.[61] However, as each side has mobilised more troops for the war, this has placed even greater demands on their industrial bases to deliver more equipment, tanks, helicopters and aircraft as well as munitions.

Large scale major combat operations, as witnessed during the Russian invasion, expend enormous amounts of munitions. High rates of consumption and relatively lower munition reserves resulted in Ukraine running short of key munitions. In June, Deputy Head of Ukrainian Military Intelligence, Vadym Skibitsky, provided an indication of ammunition consumption advising that Ukraine was firing 5,000-6,000 artillery rounds a day. While sources vary, by comparison Russian forces were estimated to be firing an average of 20,000 artillery rounds a day.[62] US analysis also noted that in the first 68 days of the invasion, Russia launched over 2,125 cruise and ballistic missiles as well as debuting the *Kinzhal* hypersonic missile in action.[63] RUSI's Alex Vershinin analysed these consumption rates against US annual production. Drawing from Russian Ministry of Defense data, he calculated that the total annual US artillery munition production when compared with average daily Russian consumption rates, would *at best* be sufficient for 5 weeks and *at worst* for less than 2 weeks of typical combat in Ukraine. He also highlighted that ATGMs, SAMs, rockets, cruise and ballistic missiles were all being expended at rates far exceeding annual production rates.[64]

In response, European and other Western countries have begun to address supply shortfalls in Ukraine's war effort. As stocks of equipment and munitions have been depleted, donations of military aid and the supply of weapons, vehicles, equipment and ammunition has enabled Ukraine to continue to fight. One source quoted a figure of 806,000 rounds of artillery ammunition provided by the U.S alone during the early stages of the fighting.[65] Importantly, this aid has largely flowed through ground lines-of-communication passing through Ukraine's western border and via air lift, due to the loss of sea lines-of-communication through the Black Sea. Should these ground lines-of-communication be interdicted, then Ukraine's munition, vehicle and equipment challenges would grow significantly.

Figure 7. Munitions dump in Ukraine (source: MilitaryImages.net).[66]

Given the available data, five deductions are made. First, the war has reinforced the need to have adequate logistics in place prior to the commencement of a conflict. In order to enable the rapid resupply and replacement of assets consumed by combat, the necessary facilities, infrastructure, transport networks and workforce to manufacture, store, maintain and deliver them need to exist in industry or industry must be

able to be repurposed quickly to support war. Second, in a prolonged war featuring major combat operations, it is critical that there is industry in place to manufacture large quantities of ammunition. Given Australia's geo-strategic circumstances, the assumption that it could rely on foreign countries to donate or supply ammunition quickly warrants particular scrutiny. Even if this were the case, it would require considerable effort to secure sea and air lines-of-communication, requiring the allocation of scarce sea and air assets.

Third, major combat operations exact a very significant toll on the nations which fight them. Given the magnitude of major combat operations involving hundreds of thousands of soldiers, thousands of AFV and artillery systems, fighting hundreds of engagements and dozens of major battles; personnel casualties and vehicle losses accord with this scale. In light of this, Army could review its mobilisation approach and assess the ways in which it could expand its personnel base to fight a long-term large-scale war. Previous approaches such as the Ready Reserve, and High Readiness Reserve, which provided fully-trained but part-time soldiers, may help inform this analysis. Fourth, Army could explore the capability requirements and training required to enable CSS organisations to better defend themselves in non-contiguous and non-linear battle space. Fifth, Army could review the capability requirements for CSS elements integral to combat units. Specifically, it may examine the levels of protection and mobility required to enable them to operate in close proximity to enemy fires and off-road to avoid predictable routes.

Conclusion

This Spotlight Brief has explored the Russian application of combined-arms during the invasion of Ukraine in 2022. It began with an examination of the key Russian tactical formations and units, covering the Motorized Rifle Brigade and the Battalion Tactical Group. It noted the significant capabilities that this organisation contained and highlighted the challenges Russian brigades faced when force generating battalion tactical groups. It subsequently explored five aspects relevant to the tactical application of combined-arms: Command and Control, Armour and Infantry, Artillery, Air-Land integration and Sustainment.

The examination of Russian Command, Control and Communications highlighted the issues which led to the invasion force being ill-prepared to conduct prolonged operations and the impact of ad hoc approaches to generating BTG. Discussion on Armour and Infantry highlighted the necessity of AFV to ground combat, the importance of adequate numbers of infantry and the need for modern AFV equipped with active and passive protection systems to counter contemporary anti-armour weapons. The importance of Artillery to the Russian way of warfare was examined as were observations of its use to destroy population centres. The examination of Air-Land integration during the invasion identified that air superiority was not assured in peer-on-peer conflict, highlighting the criticality of coordinating and integrating GBAD and UAV into the combined-arms team. Finally, a number of Sustainment challenges faced by the Russian forces were discussed. These included the impact of non-contiguous and non-linear battle space on ground-lines-of-communication, replacement of combat losses both in terms of personnel and vehicles; and the prodigious consumption of munitions during the conflict. From these observations a number of deductions were made which are summarised below.

Summary Observations

Command Control and Communications

- Future conflict may occur with little, if any warning. Therefore, individual and collective readiness measures should reflect changes in strategic warning time.
- C3 systems need to be compatible force-wide to enable interoperability between units when employed across multiple formations.
- To achieve cohesion, combined-arms organisations must train how they intend to fight during force generation.
- Army could investigate its ability to operate with alternate secure means in an environment where C3 systems such as combat net radios, battle management systems and GPS are degraded or denied.
- Army could seek to reduce its operating signature in the electro-magnetic spectrum. This could include tightening communications security to reduce open-source intelligence data mining such as via social media, mobile phones, and email.

Armour and Infantry

- The AFV's unique blend of firepower, mobility and protection make them essential to defeating enemy forces and to seize and hold ground.
- Modern AFVs are vital to survive contemporary anti-armour threats and succeed in close combat.
- Infantry and Armour must be employed in appropriate ratios to be effective.
- Armour and Infantry must routinely train together to form the habitual relationships necessary to mutually support each other in close combat.

Artillery

- Massed or even long-range precision fires alone are not decisive in ground combat. Equally, manoeuvre without adequate fire support has proven costly. The combination of armour, infantry and artillery in well-led, well-trained and well-supported combined-arms teams remains the *sine qua non* for success in ground combat.

- In potential future conflict in and around cities, artillery observers/joint fire teams must have the ability to operate in close proximity to the point of contact between enemy and friendly forces. This is necessary to achieve the highest levels of precision, accuracy and discrimination and reduce the risk of collateral damage and civilian casualties.
- As Army adopts more capable artillery systems such as SPH, MRL, long-range precision strike and anti-ship missile systems, it will be able to engage targets across the enemy's breadth and depth. Army may need to examine its how it employs artillery and its ISR assets such as cavalry, UAV, EW and aviation to determine how these systems are best employed to conduct deep strike in coordination with armour and infantry.

Air-Land Integration

- In potential future peer-on-peer conflict, Australian forces are unlikely to enjoy the freedom of action afforded by uncontested air space. Therefore, ground forces must be prepared to operate in a contested air environment.
- Army could expand its UAV capability by acquiring armed UAV to enable it to augment its airborne strike and close air support capabilities. These could be complemented by acquiring cheap, expendable loitering UAV.
- Army could acquire a very-short range GBAD system which provides a C-UAS capability to complement its short-range GBAD systems.
- Army could examine its contribution to Air-Land integration, by considering its role in an Australian concept of *air denial*. Specifically, it might explore how it would employ its mobile air-defence systems within a broader integrated joint air defence system and how it would find and destroy an enemy's air defence systems.

Sustainment

- Adequate logistics need to be in place prior to war to enable the rapid resupply and replacement of assets consumed by combat. This includes not only war-stocks of food, fuels and munitions, but the facilities, infrastructure, transport networks and workforce to manufacture, store, maintain and deliver them.

- It is critical that there is industry in place to manufacture large quantities of ammunition before conflict occurs. Given Australia's geo-strategic circumstances, the assumption that it could rely on foreign countries to donate or supply ammunition quickly warrants particular scrutiny.
- Army may need to examine its mobilisation approach and assess the ways in which it could expand its personnel base to fight a large-scale war. Previous approaches such as the Ready Reserve and High Readiness Reserve, which provided fully-trained but part-time soldiers, may help inform this analysis.
- Army could explore the capability requirements and training required to enable CSS organisations to better defend themselves in non-contiguous and non-linear battle space.
- Army could review the capability requirements for CSS elements integral to combat units. Specifically, it may examine the levels of protection and mobility required to enable them to operate in close proximity to enemy fires and off-road to avoid predictable routes.

While information on the war in Ukraine is imperfect, efforts to analyse it and derive lessons are timely and important. Absolute assessments are problematic while the war is underway and these risk premature and speculative conclusions. Within this caveat, available data has been cautiously examined to make observations, discern trends and draw deductions. This paper provides the basis from which further analysis, particularly on the deductions it has made, could commence. As the war progresses and further data becomes available, deeper and more nuanced analysis should be undertaken.

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