

Armed robotic systems like Rheinmetall's Mission Master have successfully demonstrated their ability to complement combat units undertaking a number of tasks.



MAJOR TRENDS IN GROUND COMBAT SYSTEMS

The recognition of the critical role of ground combat systems in the conduct of modern warfare has received renewed attention in recent times, as threats associated with the likes of Russia and China grow.

By Stephen W. Miller

Combat arms, once traditional pillars in the execution of successful battlefield operations, found themselves neglected or even disbanded with the shift of focus to the War on Terror and conflicts in Iraq and Afghanistan. As a result, the contribution of armoured combat vehicles, main battle tanks (MBT), mobile artillery and tactical air defence were largely unappreciated. In addition, many basic combat skills such as operating in a

communications- and signal-challenged environment, counter-reconnaissance, surveillance and tactical movement were essentially lost.

Even more serious, the emphasis on counterinsurgency allowed the unrecognised or, at least underappreciated, emergence of technologies and capabilities such as the unmanned aerial vehicle (UAV) without full recognition of their potential application or of necessary counters to them. The Ukraine conflict has

been a factor stimulating a resurgence of activity in ground combat systems, now at accelerated pace. Much of this has been through industry initiatives coordinated with militaries, and the pace and diversity of these trends within each combat discipline deserve proper attention.

MAIN BATTLE TANKS

Despite some initial predictions of the demise of the MBT based on early observations of the Russian assault on

Ukraine, the fact is that the tank continues to be the primary means to project mobile, protected firepower and shock effect on the battlefield. In response, notable efforts have been undertaken to pursue further evolution of MBTs.

One of these programmes is Rheinmetall's Panther KF51 with fully NATO Generic Vehicle Architecture; a 130mm main cannon; automatic loading; remote weapon station (RWS); active, reactive and passive protection including top-attack protection system; and integrated crew stations. To enhance tactical mobility, the KF51 has a combat weight of 59 tonnes, while continuing to utilise the proven chassis and automotive design of the latest Leopard 2. The KF51 debuted in 2022 and is now part of a collaboration by the company and Leonardo aimed towards the Italian Army.

Another programme is the Enhanced Main Battle Tank (EMBT) demonstrator, a joint effort by the French company Nexter Defence Systems and German company Krauss-Maffei Wegmann (KMW). The EMBT uses the Leopard 2 chassis with a 1,500hp MTU powerpack, a new turret, digital fire controls and integrated multi-sensor

Rheinmetall's KF51 Panther incorporates features to accommodate projected threats in future combat operations. The KF51 has already been adopted by Hungary and Italy.



suite. Its armament is the 120mm L/52 smoothbore cannon with a coaxial 12.7mm machine gun, 7.62mm roof RWS plus a 30mm ARC30 autocannon on the turret rear. In 2024 the EMBT was displayed with an unmanned ASCALON demonstrator turret equipped with a 140mm ASCALON gun and autoloader. This turret includes integral top-attack protection, a counter-unmanned aerial system (C-UAS) RWS with optical and radar sensors, and a hemispheric soft-kill

active protection system.

Elsewhere, the US Army's MBT supplier General Dynamics Land Systems (GDLS) has displayed its Abrams-X, reflecting the US decision to end its continued SEP improvements to the M1A2 MBT. The Abrams-X incorporates many of the capabilities intended for the final M1A2 version, while also focusing on reduced combat weight, crew protection improvements, and an unmanned turret



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The RCH 155 (Remote-Controlled Howitzer 155mm) is a wheeled self-propelled howitzer developed by Krauss-Maffei Wegmann. It employs the same gun as the PzH2000.

with an autoloader. In addition, it contains a new Cummins advanced combat engine with an SAPA advanced combat transmission. According to General Dynamics, "This hybrid powerpack brings benefits of silent watch, increased range and reduced signature."

Each development reflects goals of turning back MBT weight increases of the last decade, maintaining mobility, utilising digitalisation, processing and artificial intelligence (AI) to enhance situational awareness and data exchange, improve protection and counter the aerial threats of drones and even precision weapons.

INFANTRY FIGHTING VEHICLES AND PERSONNEL CARRIERS

While the direction of MBTs appears to demonstrate some consensus, their supporting armoured carriers are trending in two lines – tracked infantry fighting vehicles (IFV) and wheeled armoured carriers.

The US Army has stated its priority is its XM-30 Mechanized Infantry Combat Vehicle (MICV) to replace the M2 Bradley, which has established a favourable reputation in Ukraine. The two selected detailed-design contactors, GDLS and American Rheinmetall Vehicles, are expected to proceed to the critical prototyping and

testing phase in 2025/26. Proceeding to major acquisition with low-rate initial production was planned for FY2028, with full-rate production anticipated by FY2030.

However, recent reports saw army officials suggest initial fielding in 2027. Details of the designs remain closely held, although mention is made of the 50mm XM913 autocannon, unmanned weapon station, a minimum of six embarked infantry and use of modular open systems architecture. Initial concepts reportedly include twin anti-tank guided missiles (ATGM), AI-enabled fire controls and situational awareness, and a hybrid powerpack.

In the meantime, Rheinmetall has been chalking up a series of successes for its KF31/41 Lynx IFV. Its most recent commitment is from the Italian Army for 1,050 systems in collaboration with Leonardo. The Lynx has already been adopted by Hungary and systems were fielded to Ukraine. The Lynx's design concept features a base vehicle upon which mission role modules are fitted.

As a result, not only can it be adapted to a wide range of mission variants, but these can be appropriately configured given user-country requirements, including domestic subsystems. This adaptability provides for

alternative armaments, from the 30mm MK30-2 to the 35mm Wotan and various ATGMs. Passive protection is similarly modular, while a range of active protection systems can also be integrated. Attention is also directed toward reducing the thermal, infrared and other signatures of the vehicle.

A parallel approach to the traditional tracked combat vehicle has been the increased adoption of wheeled armoured combat vehicles. Representative of these programmes are the ARTEC Boxer, FNSS Pars, Patria AMV and GDLS LAV/Stryker. Advances in suspension have narrowed the mobility difference between tracks and wheels, at least up to moderate combat weights. As a result, multi-axle wheeled platforms can fill many battlefield roles, especially where operational mobility, reduced maintenance and high availability are key factors.

These platform attributes make such wheeled vehicles well suited to combat support tasks like air defence and combat engineering, but also in combat roles where the emphasis is on rapid manoeuvre. The ability of a unit to be ordered on short notice to effectively move extended distances of even hundreds of kilometres and be fully ready to fight remains a valuable and unique asset.

The characteristics and maturity

of RWS systems has further enhanced the adaptability of these platforms. The Common Armoured Vehicle System (CAVS), employing a Patria 6x6 design, is a cooperative manufacturing effort and will be fielded by Germany, Finland, Sweden and Latvia. It not only addresses the specific mission needs of each user, but it contributes to interoperability, shared logistics and cross-army uniformity. Examples of the flexibility and adaptability of wheeled combat vehicles is demonstrated by the German Army's selection of the Boxer, including an IFV version with a 30mm remote turret for its four new medium brigades.

In addition, Lithuania is using diverse Boxer variants such as an armoured vehicle-launched bridge, repair and recovery, armoured mortar vehicle, Serpens surveillance radar, ATGM vehicles and even a C-UAS model.

MOBILE ARTILLERY

The de-emphasis of tube artillery fostered during the War on Terror has been wiped away by the sheer volume of artillery fires employed in Ukraine. Artillery, long touted as the "king of the battlefield", has unquestionably again demonstrated its crucial contribution to combat. The need for mobility in artillery systems has been particularly highlighted too. Traditional tracked self-propelled howitzers (SPH) have demonstrated their effectiveness. Characteristics like real-time positioning, digital computation, automated laying,



The ARTEC Boxer has proven suitable for a wide range of mission roles, such as infantry carrier, reconnaissance, air defence, command, bridge-layer, ambulance and recovery.

automatic loading and high rates of burst fire, as found in the German-built PzH2000, further facilitate this lethality.

These capabilities are now considered firm requirements in contemporary artillery acquisitions. This is a major contributing factor in the success of Hanwha's K9 Thunder 155mm L/52 SPH. Users include South Korea, Australia, Poland, Finland, India, Norway, Estonia, Egypt, Turkey and Romania. The addition of a fully automated ammunition resupply vehicle with equivalent mobility (the K10 for Hanwha's K9) further enhances the combat utility of these systems.

The necessity to relocate, referred to

as "shoot and scoot", presents a dilemma for towed guns. The answer has been the introduction of truck-mounted artillery, a concept successfully pursued by France in its CAESAR. Such systems include the performance characteristics of traditional tracked SPHs, but based on a tactical truck or wheeled combat-vehicle chassis. The CAESAR can transition to a halt, fire accurately and then move again in less than 90 seconds.

The KNDS RCH-155 takes mobile wheeled howitzers in a more advanced direction by mounting an L/52 gun on a Boxer 8x8 chassis, thereby providing significantly improved off-road mobility and addressing the primary limitation of truck-mounted systems. This trend toward wheeled mobile artillery, which can be more readily and economically manufactured while proving both effective and survivable on the battlefield, is seeing universal adoption.

Another rediscovered truism of artillery employment is that range is a major advantage. This was reinforced by US Army Brigadier General Rory Crooks, Director Long-Range Precision Fires Cross-Functional Team at Army Futures Command, who called it "a number one consideration". Gaining equal or better effective range over an opponent is essential. "The problems of range, capacity and survivability based on mobility are really hard to overcome individually, and put us at risk for mission success moving forward."

The USA's latest M109A7 with an L/39



Rheinmetall's Stryker is a self-contained detection, acquisition and engagement system. It is being acquired by five NATO armies.



VTOL UAVs like the Performance Drone Works C-100 expand users' situational awareness. The C-100, along with Anduril Industries' Ghost X, was recently selected by the US Army.

barrel offers only a 30km range, even when using rocket-assisted projectiles. Thus, the PzH2000 and K9 mount a much longer L/52 tube that significantly increases the firing range, as well as opening the possibility of hosting further ammunition improvements.

TACTICAL AIR DEFENCE

Tactical air defence was widely viewed as irrelevant in the 1990s. This was initially due to the apparent assurance of air superiority by Western forces, and then later when battling insurgents without any air assets. However, the rapid employment evolution of UAVs was facilitated by their relative simplicity and ease of manufacture, allowing them to proliferate across battlefields. The limited tactical air defence assets available and the near total absence of local small-unit countermeasures compounded the impact of these new weapons, much like the machine gun did in 1914.

However, a remarkably aggressive response led by industry has seen a number of effective forward air defence solutions offered within very short timelines. This has especially been the case for systems designed for C-UAS roles. These have seen the resurrection of guns as the preferred effector, even seeing the return to active service of German 1970s-era Leopard 1 Gepard twin 35mm vehicles. The fielding of C-UAS systems has given the unusual opportunity to validate their capabilities in actual combat by deploying them in Ukraine.

The urgency in responding to this new aerial threat was initially directed toward

quick adaptations of existing weapons such as existing autocannons mounted on trucks with night vision/thermal sights. Though innovative and rapidly fielded, they were always only partial solutions. The use of radio frequency disruption using electronic means has also been widely pursued with systems like SRC's Silent Archer, the MADIS, DroneShield and other soft-kill systems.

More recently, the push has been toward kinetic hard-kill systems, with the Rheinmetall Air Defence Skyranger being a representative programme. Indicative of the urgent pace of these C-UAS developments, the Skyranger moved from conception to demonstration/pre-production in less than three years as a largely company-funded initiative. It is now being fielded by Germany, Austria, Denmark and the Netherlands, with Hungary and Italy also anticipated to commit.

As explained by a Rheinmetall representative, both the Skyranger 30 and 35 and the fixed-site SkyShield "make use of advanced-technology AHEAD ammunition that maximises lethality with minimum fired rounds".

The US Army sole-source award to BAE Systems in December 2024 for development of a 155mm Multi-Domain Artillery Cannon (MDAC) and Hypervelocity Projectile (HVP) prototype for site air defence suggests the cannon's role in counter-air has returned.

UNMANNED SYSTEMS – AERIAL AND GROUND

The roles and future position of unmanned systems, particularly small- to medium-size

Class 1, 2, and 3 aerial systems, remains somewhat unclear for most armies. UAVs like the Black Hornet and various quadcopters have demonstrated the ability to extend the situational awareness of ground units. It is further recognised that vertical-take-off-and-landing (VTOL) capabilities offer significant advantages.

General James Rainey, Commanding General US Army Futures Command, highlighted this in describing its selections for the company-level small UAS programme. "This requirement describes the importance of considering the UAS as a system, not just an air vehicle, and also highlights the importance of adaptability." Both the Ghost X from Anduril Industries and the C-100 from Performance Drone Works are VTOL systems. On the other hand, other than examples like the Switchblade and Hero, militaries have not yet fully determined how loitering munitions such as first-person-view UAVs may be integrated into their forces.

Similarly, the apparent enthusiasm of the Ukrainian military toward rapid, near-term introduction of unmanned ground vehicles for combat roles is not yet matched elsewhere. A key reason is that for Ukraine it is a potential solution to their manpower disadvantage. Interestingly, this numerical discrepancy is also faced by European armies and those facing China.

Unmanned ground combat vehicle efforts are being pursued in Western armies, though possibly too deliberately. Poland, Germany, the UK and USA have initiatives under way, with the Netherlands and Estonia undertaking substantial efforts. Proven systems include Rheinmetall with its Mission Master, Milrem's THeMIS, Textron's Ripsaw M5 and GDL's S-MET and TRX.

PROJECTING FORWARD

The battlefield lessons being demonstrated in Ukraine are clearly influencing the direction being taken in ground combat system programmes. It has both reestablished and reinforced historic knowledge such as the role of artillery, and presented new challenges such as UAVs that need to be addressed. Hand in hand, there must also be an evolution in tactics to both optimise the benefits of these new capabilities. This may be the larger challenge and require greater introspection too. **A**