

European Security & Defence

€8.90
D 14974 E



10/2022

International Security and Defence Journal



COUNTRY FOCUS:
NORWAY



Ground-Based Hypersonic Weapons

- Over-the-Horizon Targeting
- New Ground-Based Radar Capabilities
- OMFV and RCV Programme Updates
- Western Fire Support Vehicles
- Sensor-to-Shooter Systems
- FVL Programme Update





IT'S BEST NOT TO MESS WITH AN ORIGINAL

THE ONLY PROVEN JLTV SOLUTION

Oshkosh Defense is the design authority on the Oshkosh Joint Light Tactical Vehicle (JLTV) and the premier manufacturer of armored vehicles for the U.S. military. There are a lot of uncertainties in this world, but Oshkosh isn't one of them.

COME VISIT US AT AUSA,
BOOTH #6027.

OSHKOSH
DEFENSE

Photo: author



A Time of Upheaval

In the wake of Ukraine's highly impressive territorial gains in Kharkiv region during September, Russia's leadership has made two key responses. The first was the 20 September announcement of referenda to formally incorporate the Donetsk, Luhansk, Kherson, and Zaporizhzhia Oblasts into the territory of the Russian Federation. The outcomes of these are widely expected to be fairly predictable. The second was the 21 September announcement of a partial mobilisation of the Russian civilian population.

These two policies seem to reinforce one another in various ways which are intended to change the dynamic of the conflict. For instance, the formal integration of these Oblasts of Ukraine into Russia will clear some of the bureaucratic hurdles to stationing conscripts in these areas. This move could allow Russia to patch up some of the gaps in its defences in the East of Ukraine, at least on paper. While Ukraine's soldiers rightly deserve credit for their success in Kharkiv Oblast, it is also true that such gains were in part down to Russia relocating many of its combat-effective forces to defend Kherson, leaving Russia's forces in Kharkiv region weakened. An influx of new manpower would therefore seem to be a solution to this problem.

However, the jury is still out on whether or not Russia's patching up of their defences in occupied territories will be enough to keep these areas under their control, especially given that many of the newly-conscripted forces will likely have minimal training and low motivation to fight. Indeed, the mass exodus of many fighting-age Russian men from the country following the mobilisation announcement should be a stark reminder to the Kremlin that the views of many Russians do not align with their own, and that dissenters can still vote with their feet, at least for the time being. Limited, preliminary reports on social media also suggest that the mobilised civilians are not being particularly well equipped, and questions remain over how Russia's training and logistics will handle a large influx of personnel in a short time.

The move is also generating significant social unrest within Russia, which is likely to make the population diminishingly receptive to the Kremlin's messaging over time. While large-scale organised resistance does not appear to have manifested within Russia so far, as the war begins to affect more and more people, this may not remain the case for very long.

Yet even if the new influx of recruits does not have the battlefield effect the Kremlin hopes for, it is by no means their only tool. Perhaps most worryingly, the annexation would also mean that Russia's nuclear use policy could be extended to cover these newly-acquired regions, discouraging further advances by Ukraine. While the nuclear threshold is likely to remain high, given the costs to Russia of employing such weapons, it will nonetheless give them a measure of escalation control, making repeats of Ukraine's Kharkiv offensive riskier. It is also possibly the first genuine example of nuclear threats being used as an active component of Russia's Cross-domain Coercion strategic concept during a full-scale war, and indicates how serious the situation has become for Russia.

Yet, even beset by all these problems, a total defeat of Russia's forces in the field does not seem likely at this time. With mobilisation in progress and winter descending on Europe, sadly, a rapid end to the conflict still does not appear in sight. At present, Ukrainian resolve and Western support appear to be going strong, but it bears reminding that this war remains a marathon rather than a sprint. With the spectre of nuclear threats hanging over the conflict, it is imperative that Ukraine and its Western allies prepare in case the conflict strays into uncharted waters.

Mark Czalet

Contents

■ SECURITY POLICY

- 14 **Libya – Between Chaos and Uncertainty**
Andreea Stoian Karadeli
- 18 **Learning from Recent Wars**
Observations from the Second Nagorno-Karabakh War and the Russian-Ukrainian War
John Antal
- 21 **Is a Europe post-NATO Still Possible?**
Giulia Tilenni
- 24 **We will do our Utmost to Use Taxpayers' Money Well and Efficiently**
Interview with Defence Minister Christine Lambrecht
- 28 **"Finland has Longstanding Armaments Cooperation with NATO"**
Interview with Lt.Gen. Timo Kakkola, Deputy Chief of Staff, Logistics and Armaments of the Finnish Ministry of Defence
- 30 **Amid Western Concerns, India Sends Army Contingent to Russian Vostok 2022 Exercise**
Suman Sharma
- 33 **The EU's Vanishing Dream of Energy Security**
How a Desperate Shift Away from Russian Energy Dependence Ushers in a Greater Challenge for the European Union
Brendan P. Dziama & Juan Manuel Chomón Pérez

■ ARMAMENT & TECHNOLOGY

- 38 **Lightweight Mobile Field Artillery**
A game changer for land operations?
Jean-Francois Auran
- 46 **Mortar Systems Become More Mobile and Effective**
Christopher F Foss
- 52 **Ground-Based Hypersonic Weapons**
Sidney E. Dean
- 58 **Protection and Security of Water Supplies**
Dan Kaszeta
- 61 **ITAR-Related Obstacles to Exports**
Manuela Tudosia
- 64 **New Technologies Boost Ground-Radar Capabilities**
Doug Richardson
- 68 **Western Solutions for Fire Support Vehicles and Medium Tanks**
Luca Peruzzi
- 72 **The Long Road...**
Shaun Connors
- 74 **OMFV and RCV Programme Updates**
Sidney E. Dean
- 80 **Sensor to Shooter Chains Turn into Kill Webs**
Tamir Eshel
- 82 **US Army Future Vertical Lift: A Status Report**
Sidney E. Dean
- 86 **The Search for Game-Changers in Ukraine**
Mark Cazalet

- 90 **Infantry Load-Carrying Options**
André Forkert
- 94 **Military Trucks Get Harder**
Christopher F Foss
- 98 **US Army Introduces Drone Swarms into its Training**
Sam Cranny-Evans
- 99 **Over the Horizon Sensing, Targeting, and Attack**
Tamir Eshel
- 102 **Thunderstruck! – Hanwha Unveils K9A2 SPH Prototype**
Mark Cazalet
- 104 **India's Light Tank Programme, a Mountain to Climb**
Sam Cranny-Evans

■ COUNTRY FOCUS: NORWAY

- 107 **Norway's Security Environment and Role in NATO**
Robert Czulda
- 112 **Is the War in Ukraine Affecting Norway's Security Situation?**
Björn Josefsen
- 116 **Capabilities Made in Norway – Norwegian Defence Industry Delivers World-Class Defence Equipment to Armed Forces around the World**
Torbjörn Svensgard

■ INDUSTRY & MARKETS

- 120 **Saab Conducts Successful MSHORAD Live Fire Demonstration**
Mark Cazalet
- 121 **"Special Attention will be Paid to Innovation."**
Interview with Hugues d'Argentré, Director of SOGENA

■ ARMED FORCES

- 123 **Cyber Warfare in Eastern Europe**
Andreea Stoian Karadeli
- 127 **Developing Excellence in EOD**
Interview with Colonel Róbert Császár of the Slovakian Army, director of the NATO EOD CoE

■ VIEWPOINT FROM ...

- 51 **London**
Tim Guest
- 106 **New Delhi**
Suman Sharma

■ COLUMNS

- 1 **Editorial**
- 3 **ESD Spotlight**
- 12 **Firms & Faces**
- 89 **Masthead**
- 122 **Index of Advertisers**

■ MSI Unveils Details of their TERRAHAWK VSHORAD System

(mc) The Norfolk-based company MSI displayed their TERRAHAWK Very Short Range Air Defence (VSHORAD) flatbed-based mobile air defence system for the first time at DVD 2022. The system is primarily aimed at countering Class 1 and Class 2 Unmanned



Photo: Mark Cazalet

Aerial Vehicle (UAV) threats, and is notionally being promoted as an automatic cannon-based system, although an MSI representative stated that various other effectors could be used instead if specified by the user.

The configuration shown at DVD was an 'all-in-one' version of the system, with sensors and effectors mounted on a single Demountable Rack Offload and Pickup System (DROPS) type flat load bed. The system is intended to be platform-agnostic, and is capable of being mounted on any vehicle with the requisite space and payload carrying capacity, which in this case would typically be trucks. An MSI representative stated that a decoupled version of their solution, with sensors, effector, and control system mounted on separate bases linked via fibre optic cable, had already entered use with a Gulf state customer.

In terms of major system components, the front-left of the flat load bed was fitted with a mast hosting four RADA MHR S-band Active Electronically Scanned Array (AESA) pulse doppler radars and MSI's SATOS optical sensor head with HD Day, HD Thermal, and laser rangefinder (LRF) channels. The configuration of four radars fixed at 90° to one another permits coverage through 360°, and according to an MSI representative, the MHR radars are able to detect Class 1 UAVs out to 5 km, or Class 2 UAVs out to 25 km. The sensor head is responsible for fire control, and can be cued to a detected target's azimuth and elevation based on tracks from the radars.

At the rear of the load bed is a remote weapon station (RWS) armed with a Northrop Grumman Mk44 Bushmaster II 30 mm dual-feed automatic cannon. The MSI representative stated that the company offers the RWS in two configurations – light and heavy. The primary difference between the two is the

amount of ammo stored, with the light configuration having 200 ready to fire rounds, split between two ammunition stowage bins located on either side, while the heavy configuration has 400 ready rounds, also split between two stowage bins. To power the system, a power supply was fitted at the front-right of the load bed.

It is noteworthy that the remote weapon station is completely decoupled from the sight used by the weapon for fire control. While an atypical arrangement on most vehicles, an MSI representative stated that this arrangement offered the benefit of lower vibration felt by the optic during firing, since it is mounted much further from the cannon than usual.

For use with the TERRAHAWK VSHORAD system, the Mk44 would typically be expected to be equipped with Programmable Air Burst Munitions (PABM) rounds or Proximity-Fuzed rounds, since conventional rounds would typically be much less effective against UAV threats. An MSI representative stated that the company has tested both natures of ammunition, resulting in a notional effective range from 600 m out to 1.8-2 km for PABM rounds, and from 800 m out to 1.6-1.8 km for the air burst rounds.

Developmentally, the system is at Technology Readiness Level (TRL) 2 at the moment, however as already noted, the decoupled version of the system is already in service, so the level of effort required to complete the all-in-one configuration would presumably not require many years. The version shown at DVD was a prototype, with a few key differences from the envisaged final version. Among these are replacing the prototype's fixed sensor mast with a telescoping mast to allow easier transport, and the addition of hydraulic outriggers, which could be used to help stabilise the vehicle when stopping to fire.

■ RBSL Provides Update on Fuchs CBRN Upgrade Contract

(mc) On 21 September 2022, Rheinmetall BAE Systems Land (RBSL) announced that it had so far completed the upgrade and delivery of six FUCHS CBRN Reconnaissance vehicles, out of ten previously contracted in September 2020. The company added that



Photo: British Army

the remaining four vehicles were on track to complete their upgrade process by the end of 2022. The vehicles are operated by Falcon Squadron, part of 28 Engineer Regiment, based at Harman Lines, in the West of the UK.

The GBP 16 million upgrade contract covered the replacement of legacy Chemical Radiological Nuclear (CRN) mission equipment, addressing obsolescence issues and providing in-service support for the UK's fleet of 10 FUCHS CBRN 6x6 vehicles. The UK's vehicles were originally produced by Rheinmetall, and gifted to the British Government during the First Gulf War.

■ MBDA, RBSL, and Supacat Unveil Solutions for UK MoD's BGOAA Programme

(mc) At the DVD 2022 defence exhibition, RBSL and Supacat both unveiled carrier platforms for MBDA's BRIMSTONE guided missile, aimed at the UK Ministry of Defence's (MoD) Battle Group Organic Anti-Armour (BGOAA) programme which aims to replace some of the UK's legacy ground-based anti-armour guided weapon systems.

The concept is not entirely new territory for MBDA, with the company having previously demonstrated several vehicles developed around a similar concept, and first shown



Photo: Mark Cazalet

at MSPO 2019 in Poland. These concept demonstrators were developed in conjunction with local industry for Poland's Ottokar Brzoza programme. While the winner of this programme has not yet been selected, and final details such as carrier platform remain to be worked out, MBDA's BRIMSTONE is expected to be selected as part of the solution.

In much the same manner as with Ottokar Brzoza, the two examples shown for the BGOAA programme featured collaboration with local industry, in this case with Supacat and RBSL for respective light and heavy implementations of the concept. Supacat's version was designated 'Brimstone HMT Overwatch', and was based on an enclosed cab version of their company's 6x6

Photo: Stephen Barnard



High Mobility Transport (HMT) design, and armed with an elevating launcher armed with eight Brimstone missiles. RBSL's version was designated 'BRIMSTONE OVERWATCH ON BOXER', and consisted of a mission module option for BOXER armed with the same elevating launcher with eight Brimstone missiles, and would be compatible with the UK's BOXER drive modules already on order, requiring only a mission module swap. According to an MBDA representative, the launcher used by both vehicles was completely identical in terms of specifications.

In terms of armament, the systems are both expected to be offered with the Brimstone 3B variant, possessing an estimated range of approximately 12 km when ground-launched, which is sufficient to meet the MoD's 10 km range requirement for the BGOAA programme.

It is noteworthy that as both Ottokar Brzoza and BGOAA have progressed, the companies involved have appeared to have scaled down the number of missiles on their respective concepts. Early mock-up versions shown in Poland used a launcher armed with 12 BRIMSTONE missiles, while one early concept graphic for BGOAA showed a BOXER using a fixed-elevation launcher armed with 16 BRIMSTONE missiles. In later concepts for both programmes, the total appears to have been scaled down to 8 BRIMSTONES, albeit in Poland's case this seems partially compensated for by the decision to operate the launchers in batteries of eight vehicles, giving 64 missiles per battery. The UK's envisaged BGOAA vehicle formation structure has so far not been revealed.

In another departure from the earlier CG concept models, the 'BRIMSTONE OVERWATCH ON BOXER', featured a launcher which elevated and extended above the above the hull roof of the mission module, rather than being flush with the roof as on the original concept. An MBDA representative stated that although the launcher was higher than the hull roof, it remained within the maximum height of the UK's planned version of BOXER, which will feature large roof-mounted stowage boxes on top of the mission module, in a slight departure from versions of BOXER in foreign service.

■ WFEL Completes First Drive Module Hull for UK BOXER Programme

(mc) On 15 September 2022, WFEL announced that they had completed fabrication of the first BOXER 8x8 drive module hull for the UK's BOXER programme. According to the company, the hull has been painted and fitted with spall liner and insulation material for the driver's bay. The next step in production will be assembly and systems integration, followed by testing.

The drive module contains the vehicle's power pack, suspension and driveline, fuel system, electrics and driver's station. This is then mated with a mission module which defines the BOXER's role based on the equipment it

Photo: WFEL



is fitted with. WFEL stated that further drive module hulls were already in progress and, following the painting operation, would be available for assembly before the end of September.

The UK has ordered 623 BOXER 8x8s so far in four variants, comprising Armoured Personnel Carrier (APC), Specialist Carrier Vehicle, Command Post, and Ambulance roles. An initial batch of 523 were ordered in a 2019 contract, and a further 100 through a contract option exercised in April 2022. Of this total, 117 pre-series vehicles are being built in Germany, while the UK will domestically produce the remaining 506 at WFEL's Stockport facility and the Rheinmetall BAE Systems Land (RBSL) facility in Telford. First deliveries to the British Army are due to commence in 2023, and are understood to consist of pre-series vehicles.

■ Procurement contract for F-35A fighter aircraft signed

(gwh) Almost a year after the US authorities signed a contract for the procurement of

Photo: Lockheed Martin



36 F-35 fighter aircraft, armasuisse has now followed suit, with National Armaments Director Martin Sonderegger, and Swiss F-35A Program Manager Darko Savic, signing a contract valued at CHF 6.035 billion (EUR 6.26 billion) for 36 F-35A aircraft on 19 September 2022. The aircraft are due to be delivered between 2027 and 2030, replacing the current fleet of F/A-18 HORNET and F-5 TIGER aircraft.

The last prerequisite to signing was the Swiss Parliament providing approval for financing on 15 September, and as armasuisse announced, the procurement contract value was within the maximum approved by the Swiss electorate. In addition to the aircraft, the contract also included mission-specific equipment, ammunition, a logistics package, mission planning and evaluation systems, as well as training services and equipment. The sale was conducted through the US' Foreign Military Sales (FMS) programme, which makes the contract between the governments of Switzerland and the USA. From its side, US Government handles the procurement through its own contract with manufacturer Lockheed Martin. In this contract, the prices and the contractual conditions are fixed and binding.

The procurement contract is accompanied by an offset agreement valued at CHF 2.9 billion (EUR 3.01 billion) between armasuisse and Lockheed Martin. According to armasuisse, this forms a framework for the US manufacturer to conclude deals with Swiss industry which will compensate for Switzerland's procurement costs.

The German Armed Forces have also initiated their procurement of 35 F-35As through FMS. The cost of this is estimated at approximately EUR 8.4 billion. The aircraft are due to be delivered from 2026 and will gradually replace the PA-200 Tornado, among other things for the Bundeswehr's nuclear sharing capability. While Germany does not possess nuclear weapons of its own, under the nuclear sharing agreement Germany hosts US nuclear weapons and its jets are obliged to carry some of them to their targets in the event of a nuclear conflict.

■ Germany to Supply Four More PzH 2000 SPHs to Ukraine

(lh) The German Armed Forces will provide Ukraine with four more PzH 2000 self-propelled howitzers (SPHs) and additional ammunition. According to a Statement by the German Ministry of Defence, the delivery will be initiated immediately, "despite Germany's own strained materiel situation." According to discussions with the industry on the accelerated supply of refurbished guns from

Innovative Solutions for Multi-Domain Land Operations



Leveraging our combat-proven payloads, we offer a full spectrum of advanced systems for ground forces that support diverse mission profiles. Our unique ground and aerial solutions encompass robotic & autonomous platforms, situational awareness, survivability & force protection, low level air defense, and broadband communications.

ELTA Systems Ltd.

www.iai.co.il • market@elta.co.il



Discover More





the Army's overhaul, they are earmarked for Ukraine, it said. Defence Minister Christine Lambrecht stated that Ukraine was full of praise for the system and had expressed a desire for more SPHs. According to Lambrecht, the latest batch brings the number of PzH 2000s supplied by Germany to 14 units. In addition to Germany, the Netherlands has also delivered PzH 2000s to Ukraine, resulting in a combined total of 22 units delivered by both countries.

■ Brazil Orders 27 Airbus H125 Light Utility Helicopters

(mc) On 16 September 2022, Airbus Helicopters announced that the Brazilian armed forces have ordered 27 H125 single-engine light utility helicopters through the Combat Aircraft Programme Coordinating Committee (COPAC). The H125s are slated to replace the older AS350 and Bell 206 helicopters in service with the Brazilian Air Force and the Brazilian Navy respectively. The contracted helicopters are due to be produced at the H125 final assembly line at Helibras' factory located in Itajubá, Brazil, where H225Ms for the Brazilian armed forces are also assembled. Airbus stated that the new H125 helicopters would have a twin glass cockpit equipped with a G500H TXi flight display system and Vehicle & Engine Multifunction Display (VEMD), and would be compatible with the use of night vision goggles (NVG). They are also due to include different types of mission equipment, such as a winch and a hook, so that the training of future pilots is as representative of their missions as possible. The Brazilian armed forces presently operates a total of 156 Airbus helicopters deployed from its eight bases across the country. Its fleet includes 67 light Écureuil family helicopters (which the H125 series are de-



scended from), and 41 heavy multi-purpose H225M helicopters. This fleet is required to cover a wide range of missions including tactical transport, search and rescue, and civil support.

■ Slovenia Cancels Boxer Contract

(gwh) Following an audit report on the "Efficiency of the Procurement of 8x8 Wheeled Combat Vehicles for the Slovenian Armed Forces", the Slovenian government announced on 15 September 2022 that it had decided to withdraw from the Boxer procurement programme.

Just a few months prior, on 11 May, the then Minister of Defence Matej Tonin signed a procurement contract for 45 BOXER 8x8 armoured vehicles valued at EUR 343 million with the European procurement agency OCCAR (Organisation Conjointe de Coopération en matière d'Armement). At the same time, Slovenia had also been accepted into the OCCAR Boxer programme as an observer.

Under the terms of the contract, the first BOXER was to be delivered in 2023, reportedly intended for trials, to verify compliance with Slovenia's requirements. The other vehicles were to be delivered in three batches, consisting of nine units in 2024, 22 units in 2025, and 13 units in 2026.

According to the Slovenian government, initial invoices for development and operating costs totalling around EUR 10 million have already been received. The withdrawal from the contract will cause further costs. The OCCAR has provisionally estimated costs amounting to 20 per cent of the contract value, which would be up to 60 million euros. Slovenia's Audit Report

The Ministry of Defence's audit report criticises above all the insufficient examination of available alternative offers. A review of the decisions would not be possible, since the available offers were differently itemised. The report stated that the process had focused too early on the Boxer, and that less-costly alternatives were not examined, such as requesting a proposal from Poland's Rosomak SA, the producer of the ROSOMAK (Poland's domestically-produced variant of the Patria Armoured Modular Vehicle (AMV) 8x8) to upgrade the AMVs already in Slovenian service, where they are referred to as 'SKOV Svarun'.

The Slovenian army announcement stated that while the BOXER met the Slovenian Armed Forces' minimum requirements for firepower, ballistic and mine protection, manoeuvrability and tactical characteristics, the internal audit believed that the most expen-

sive solution had been chosen in 2018. The decision to privilege higher ballistic and mine protection than the minimum requirements had led to a smaller choice of 8x8s, and consequently, to a higher price. For these reasons, the audit was not able to judge that the purchase of the BOXER was economical. Building new battalions

The Slovenian Ministry of Defence puts the creation of a medium infantry combat battalion and a medium combat reconnaissance battalion at the centre of its considerations. According to the ministry, the medium in-



fantry combat battalion requires vehicles in a number of variants in addition to the armoured personnel carrier (APC) variant. The list includes 120 mm mortar carriers, ambulance, recovery, and command variants. According to the ministry's assessment, the expenditure for this would amount to EUR 1.4 billion. The Act for the "Provision of Funds for Investments in the Slovenian Armed Forces" currently earmarks only EUR 609 million for this purpose in the period 2021-2026. According to estimates by the General Staff, at least 433 million euros more would be needed over this period.

The cost estimate for the medium combat reconnaissance battalion is not yet available. It is expected that the reconnaissance vehicles would be more expensive than the medium infantry combat vehicles due to their additional requirements. This leads to an estimated cost of around EUR 800 million for such a battalion, but this figure does not include the infrastructure, training and life cycle of the equipment, which would require further spending.

By reducing the procurement of the intended number of 8x8s, selecting a cheaper supplier and upgrading their existing 30 AMV APCs, the ministry aims to achieve savings of at least EUR 400 million. One likely candidate to meet these requirements is the ROSOMAK, which is already produced in most of the required configurations. Its protection also meets Slovenian requirements and the ROSOMAK has already been combat proven in Afghanistan. The ministry did not want to comment on contacts with suppliers, which had already been rumoured in June.

■ Ukraine Becomes the Launch Customer for RCH 155 SPH

(gwh) The German government has approved the delivery of 18 RCH 155 self-propelled howitzers (SPHs) mounted on the BOXER 8x8 platform to Ukraine. As German newspaper 'Die Welt' was the first to report, the approval came in response to a request



Photo: KMW

by Ukraine on 14 July 2022. According to the request, Ukraine intends to order 18 RCH 155 SPHs from Krauss-Maffei Wegmann (KMW). The contract is valued at EUR 216 million, with the financing due to come from the German government's Ukraine aid fund. With the partial example of a single early RCH 155 due sooner, it is expected that deliveries may not be possible until 2025.

RCH 155

In developing the Remote Controlled Howitzer 155 (RCH 155), KMW integrated a remote turret armed with the same a 155 mm/L52 howitzer used on the PzH 2000 with a Boxer mission module.

The SPH's high level of automation allows it to be operated by a crew of just two. The electrically driven remote turret is equipped with a fully automatic loading system and inductive fuze programmer. The combat load consists of 30 ready to fire projectiles and 144 modular propelling charges. The fire control system (FCS) is automated, using a fire control computer with integrated ballistic calculation for automatic gun laying. The FCS is also provided with a radio datalink to allow cueing from nearby artillery command and control (C2) systems, and can use positioning data provided by Global Navigation Satellite System (GNSS), inertial, or other navigation systems.

The turret is capable of traverse through 360°, and the weapon has a depression/elevation range from -2.5° to +65°, allowing it to carry out both direct and indirect fire missions. The gun is capable of firing in any direction without requiring the vehicle to deploy hydraulic outriggers, which greatly speeds up the process of repositing after a fire mission. The maximum range of the weapon varies by ammunition nature, but would be approximately 40 km with base bleed ammunition, or around 54 km with V-LAP rocket assisted/base bleed ammuni-

tion. Greater ranges may also be possible, Rheinmetall has previously attained a range of 67 km from their Assegai M2005-V-LAP round from a PzH 2000 during tests in South Africa in 2019. Terminal guided projectiles, such as VULCANO, and EXCALIBUR could also be used with the RCH 155.

In mid-August 2021, KMW presented a new variant of the RCH 155, showing the system's fire on the move capability during a live fire demonstration. The newer variant featured a turret 30 cm lower than the previous version, intended to be easier to transport via road and rail. This variant also featured a remote weapon station (RWS) armed with a machine gun capable of hunter-killer functionality, enabling the operator to cue direct-fire targets for the primary armament. The crew were also provided with day cameras providing 360° coverage, which are part of the Hensoldt SETAS see-through armour system, intended to improve the crew's local situational awareness. Manufacturer qualification of this variant was completed earlier in 2022.

Artillery Weapons for Ukraine

In view of the great importance and effectiveness of long-range artillery weapons, Ukraine would like to further strengthen its own artillery over the long term. In addition to its own howitzers and those received from other countries, (so far nearly 100 howitzers in the 155 mm calibre from France, Italy, Poland, Slovakia, the Czech Republic and the



Photo: KMW

USA), Ukraine also possesses 18 PzH 2000s from German and Dutch stocks.

At the end of July, KMW had reached an agreement with Ukraine on the production and delivery of 100 PzH 2000s, valued at EUR 1.7 billion. The German government has approved the start of production, but has not yet approved their export.

According to a KMW spokesman, the approval enables the company to begin preparations for production. KMW is prepared to make advance deliveries, even though it has not yet signed a contract with Ukraine. At present, the priority is to implement production and delivery as quickly as possible.

In addition to the Bundeswehr and the Ukrainian armed forces, the armed forces of

Italy, Qatar, Lithuania, Croatia and the Netherlands also use the PzH 2000. A few years ago, Hungary also ordered the PzH 2000. However, since no deliveries have been reported so far, the production line is probably still 'warm'.

■ Luxembourg Signs Contract for 80 EAGLE V 4x4 Vehicles

(Thomas Nielsen) On 15 September 2022, the Luxembourg Army announced that it had signed a contract for 80 EAGLE V 4x4 protected patrol vehicles in the CLRV (Command, Liaison and Reconnaissance Vehicle) configuration. According to media reports, the contract has a total value of EUR 367



Photo: Luxembourg Army

million, with EUR 228.5 million committed to the initial procurement, and a further EUR 138.5 million estimated for maintenance and upgrades over the next 15 years. Initial deliveries are expected in December 2024, with the final vehicles scheduled for delivery in July 2026.

The contract was signed with General Dynamics European Land Systems (GDELS) via the NATO Support and Procurement Agency (NSPA), and includes logistical support for the vehicles from the latter. The new vehicles are intended to gradually replace the HMMWV-based Protected Reconnaissance Vehicle and the UNIMOG-based DINGO infantry mobility vehicle currently in service with the Luxembourg Army.

The CLRV is a configuration of the GDELS EAGLE V 4x4 protected patrol vehicle. It carries a crew of five, and is protected against mines and IEDs, artillery fragments, and small arms fire. The vehicle is fitted with a 212.5 kW (285 hp) diesel engine, providing a top speed of approximately 110 km/h. The Luxembourgish vehicles will be equipped with the FN Herstal DeFNder Medium remote weapon station (RWS). The DeFNder Medium is stabilised and can be armed with either the M2 HB 12.7 × 99 mm heavy machine gun or a 40 × 53 mm automatic grenade launcher. The weapon station can also

be equipped with obscurant smoke grenade launchers for additional protection. The CLRVs will be equipped with the Scorpion communications system from Thales. This system is already in service with the Belgian armed forces, and its implementation in the Luxembourg Army will enable increased interoperability between the two nations' armed forces.

■ Bundeswehr to Supply DINGOs and MARS II Artillery Systems to Ukraine

(lh) On 15 September 2022, the German Ministry of Defence stated that Germany would deliver 50 DINGO protected patrol vehicles and two additional MARS II rocket artillery systems, including associated ammunition, to Ukraine. The training of Ukrainian crews on both the DINGO and the MARS II will be carried out in Germany, and is due to begin in September.

Photo: Bundeswehr/ Marco Dorow



The DINGOs are intended to help alleviate Ukraine's demand for protected vehicles, and the vehicle has reportedly proven itself in Bundeswehr missions and mission-equivalent commitments.

The transfer of these vehicles is due to be accompanied by additional measures to lessen the impact on the Bundeswehr's operational readiness and training requirements. The Ministry did not provide further details on the measures, only stating that German contingents would not be affected by the vehicle transfer due to the accompanying measures. In its press release, the Ministry did not address the Kiev's previous requests for LEOPARD 2 family main battle tanks and MARDER infantry fighting vehicles to assist in its defence against Russia's invasion.

■ Saab Receives Submarine Life Extension Contract from Sweden

(mc) On 14 September 2022, Saab announced that they had received a contract for submarine life extension and upgrades from Sweden's Defence Materiel Admin-

Photo: Saab



istration (FMV). The contract was valued at SEK 470 million (EUR 44 million), and comprises life extension and upgrade works on the submarine HSwMS SÖDERMANLAND, along with new batteries and battery development.

As part of the life extension process, HSwMS SÖDERMANLAND will receive around 50 modifications, enhancing her capabilities and prolonging her operability for a further six years. The order also includes an exchange of the batteries used by the Swedish Navy's present submarine fleet, as well as a project focussing on battery development, to maintain Sweden's submarine capabilities over the longer term.

■ German Naval Yards Unveils SEAGUARD 96 Corvette Design

(mc) At the SMM 2022 exhibition in Hamburg, German Naval Yards unveiled their SEAGUARD 96 corvette design. The design was made by German Naval Yards in collaboration with French Company Constructions Mécaniques de Normandie (CMN) Group.

Photo: German Naval Yards



The SEAGUARD 96 corvette has a length of 96 m and a beam of 13.5 m, with a displacement of approximately 1,814 tonnes (2,000 tons) and accommodation for 60 persons. The propulsion and power generation system is based around twin main diesel engines together with four diesel generators and controllable pitch propellers, providing a maximum speed of 28 knots and an endurance of over 7,408 km (4,000 nautical miles).

The vessel is equipped with a 3D radar and can be armed with various anti-surface and anti-air weaponry and sensors. The hull form uses a slender bow section to

enhance sea keeping and fuel efficiency, while the topsides and superstructures use a low-observable and modular design, with an integrated main mast and flush side hull compartments. The stern contains a helicopter platform with a hangar.

■ Ingalls Starts Fabrication of USS Pittsburgh (LPD 31) Amphibious Transport Dock

(mc) On 9 September 2022, Ingalls Shipbuilding division announced that they had commenced fabrication of the USS PITTSBURGH (LPD 31), the US Navy's newest SAN ANTONIO Class amphibious transport dock, with the first 100 tons of steel cut for the ship.

The US Navy has so far received 12 SAN ANTONIO class ships, and three more remain under construction, including RICHARD M. MCCOOL (LPD 29), HARRISBURG (LPD 30) and PITTSBURGH (LPD 31), the latter two of which are Flight II LPDs.

The Flight II LPDs are the next amphibious ships to replace WHIDBEY ISLAND (LSD 41) and HARPERS FERRY (LSD 49) classes of dock landing ships. Amphibious transport docks are a major part of the US Navy's expeditionary force concept, deployed with a US Marine Corps Air-Ground Task Force for amphibious and expeditionary crisis response operations ranging from deterrence and joint-force enablement to humanitarian assistance and disaster relief.

■ US Army Awards Elbit Systems of America a Contract for 120 mm Mortars

On 12 September 2022, Elbit Systems announced that its US subsidiary, Elbit Systems of America was awarded a contract to provide 120mm mortar systems for the US Army. The initial delivery order was valued at USD 10 million, and is due to take place over a two-year period, with work taking place at Elbit's facility in Fort Worth, Texas. In total, the contract has a maximum potential value of up to USD 49 million, and maximum duration of up to five years.

Photo: US Army



This contract was awarded following Elbit's completion of a 2016 contract for the production of 60 mm, 81 mm, and 120 mm mortars, valued at USD 103 million.

■ Damen Naval Awards MAN Energy Solutions Contract for Propulsion Diesel Engines for F126 Frigates

(mc) At the SMM exhibition in Hamburg, Damen Naval announced that they had awarded MAN Energy Solutions a contract for eight MAN 32/44CR propulsion engines for Germany's F126 frigate programme. The engines will form part of a combined diesel-electric and diesel (CODLAD) propulsion system, providing the vessels with a top speed of over 26 knots. The first engines are due to be delivered to the shipyard in early 2024, and the first frigate is due to be delivered to the German Navy in 2028.



Photo: Damen

Damen stated that each vessel will be equipped with 2 x MAN 32/44CR engines, with each engine featuring proprietary MAN Selective Catalytic Reduction (SCR) systems to comply with IMO Tier III regulations. Furthermore, the engines will be equipped with a high-displacement, soft-resilient mounting system to comply with shock and noise regulations. MAN Energy Solutions will also supply their engine control system software, which is protected against cyber attacks.

■ Airbus Selected to Provide Satellite Communications for Armed Forces of Czech Republic and the Netherlands

(mc) On 9 September 2022, Airbus signed contracts with the Ministries of Defence of Czech Republic and the Netherlands to provide satellite communications for a 15-year period. The Armed Forces of the Czech Republic and The Netherlands will respectively utilise two and three channels of the Airbus



Photo: French Ministry of Armed Forces

Ultra-High Frequency (UHF) military communications payload hosted on-board the EUTELSAT 36D telecommunications satellite scheduled for launch in 2024.

The EUTELSAT 36D satellite will be built by Airbus, based on its Eurostar Neo platform. In addition to the UHF payload, it will also be equipped with 70 Ku-band transponders for TV broadcasting. The UHF payload will be operated from Airbus's Network Operations Centre in Toulouse. Its 18 UHF channels will enable up to 200 simultaneous communications over Europe, the Middle East, Africa, large parts of Asia, as well as the Atlantic Ocean (to eastern Brazil) and the Indian Ocean (to western Australia).

Airbus stated that with this new UHF payload, the company would be able to offer a new UHF communications service to the armed forces, particularly to those of European countries and NATO members. According to the company, the UHF frequency band is a relatively scarce orbital resource, and so this offering will somewhat make up for the capacity shortage around the world. Airbus said they'd already signed several firm orders for this capacity ahead of the satellite's scheduled launch.

■ Poland to Buy 96 AH-64E Helicopters

(ck) On 8 September 2022, The Polish Ministry of Defence announced that the Polish government is seeking to procure a total of 96 AH-64E GUARDIAN (APACHE family) attack helicopters from the United States for its KRUK attack helicopter programme.



Photo: Polish MoD

The announcement took place amid talks between Polish Defence Minister Mariusz Błaszczak and his US counterpart Lloyd Austin during a meeting of the Ukraine Contact Group at the Ramstein airbase. According to the Polish MoD, the helicopters are intended to be operated alongside Abrams main battle tanks (MBTs), which have also been ordered from the US. As a stop-gap measure, Poland intends to lease Apaches from US stocks until its own are delivered.

In a statement, Apache manufacturer Boeing welcomed Poland's selection of the AH-64E (v6) configuration for the KRUK

programme. Boeing stated that it will continue to expand its partnership with Polish defence holding company Polska Grupa Zbrojeniowa (PGZ).

■ ISS Provides Details on Participation in UK MoD's Gap-Crossing Formation Reconnaissance Exercise

(mc) At the Helitech/DroneX 2022 exhibition, ISS Aerospace revealed details of their participation in the UK MoD's 'Map the Gap' autonomous gap crossing survey Phase 2 competition. In essence, this exercise aims to trial various autonomous means of conducting formation reconnaissance for wet gap crossings, such as rivers or canals, with a particular focus on gaps greater than 40 m in width.



Photo: Mark Cazalet

According to the MoD, at present, the only way of identifying suitable crossing points is to send Royal Engineer reconnaissance troops to survey both banks of the wet gap. These methods are laborious and require the use of manually operated survey equipment to take readings to generate a gap profile and obtain key characteristics, such as the banks' ground bearing capacity, the slope angle of the river's banks, the speed of the water, and others. All of these characteristics are used to inform the crossing requirements of the formation. The MoD's goal is therefore to find a means of using autonomous systems in order to greatly speed up the process of finding suitable crossing points.

Dr Tony Klein, Non-Executive Director at ISS Aerospace, stated that the company had submitted their SENSUS 8 outfitted with a suite of sensors and instruments for the gap mapping task. These included a ground penetrating radar (GPR) for determining soil profile, a bathymetric LIDAR to map the wet gap floor, photogrammetric cameras to build up 3D images of the terrain, two dropping darts for measuring ground firmness and moisture content, and a flotation 'egg' used for measuring the speed of flowing water. According to Klein, the system used in the competition is also outfitted with an on-board processor to speed up data processing time. The data are processed on board the platform, and

the relevant readings can then be wirelessly transmitted to the relevant personnel. All of these pieces of equipment are be fitted in or around the 'annulus' (ring-shaped) airframe of their SENSUS 8 UAV platform. The UAV uses a quadcopter-type design albeit has fitted with eight coaxial propellers, with two pairs per arm. The platform has a total payload capacity of 25 kg, and can be powered by either two battery packs or by a hydrogen fuel cell hooked up to a hydrogen tank. Klein stated that the fuel cell provides the platform with 2.4 kW of power, and the higher-capacity hydrogen canisters contain sufficient fuel for an endurance of 2.5 hours. Klein stated that during competitive testing, ISS' UAV-based solution was able to complete the gap mapping process in a shorter timespan than the unmanned surface vehicle (USV) and unmanned ground vehicle (UGV) solutions they were competing against.

■ PGZ and Hyundai Rotem sign far-reaching cooperation agreement

(Kristóf Nagy) Korea's Hyundai Rotem and Polish company Polska Grupa Zbrojeniowa (PGZ) have signed a far-reaching cooperation agreement. This was announced by PGZ on the sidelines of the MSPO 2022 defence trade fair taking place in Kielce, Poland. The subject of the agreement is the development and production of main battle tanks (MBTs), infantry fighting vehicles (IFVs) and unmanned ground vehicles (UGVs).

According to PGZ, the future cooperation agreement will primarily focus on research and development, production, repair, and modernisation of systems for both the Polish and export markets. PGZ President Sebastian Chwałek also provided commentary on the planned timetable, stating that first on the agenda is the announcement of the production site for the Korean K2 BLACK PANTHER MBT in Poland. This ties in with Defence Minister Mariusz Błaszczak's July announcement of Poland's decision to purchase of around 980 K2 MBTs, of which 800 are to be manufactured in Poland as the K2PL variant.

The cooperation agreement also extends to the development of the K3 MBT as well as a protected 8x8 wheeled vehicle with an automatic cannon armament, models of both were displayed at MSPO. The third part of the announcement includes an undefined UGV development – it remained open whether this will be a single vehicle or a whole family of systems.

Poland has been increasing the pace of armament procurement at least since the summer of 2021. In this context, there has been a heavy focus on armoured vehicles. The Min-



Photo: Hyundai Rotem

istry of Defence has already purchased 250 M1A2 SEPv3 main battle tanks, 6 M88A2 Hercules armoured recovery vehicles and 17 M1110 bridging systems from the USA for EUR 5.3 billion. The outbreak of the War in Ukraine has further accelerated this process – numerous changes to the law have been implemented, which, among other things, allows an increase in the size of Poland's armed forces. In addition, Poland wants to spend 3% of its GDP on defence as early as next year, a substantial increase over previous spending.

■ Camaro-Tech Announces the Purchase of their Xaver LR40 Through-the-Wall Radar by a European Police Special Force

(mc) On 8 September 2022, Camaro-Tech systems announced they had received a contract for the purchase of their XAVER LR40 radar system, by a Western European police special forces group. The XAVER LR40 is a pulsed ultra-wideband (UWB) radar capable of detecting of living objects behind walls, at distances of more than 50 meters. Such features are intended for special forces and law enforcement teams conducting search or reconnaissance operations in urban environments.

According to the manufacturer, the through-the-wall radar system is capable of detecting the exact distance of people, as well as their number and their direction of movement.



Photo: Camaro-Tech

Camaro-Tech added that the system is also sufficiently sensitive to detect micro-movements of static living objects.

The system is controlled by a single operator via a tablet, and features integrated data recording and playback for

post-mission analysis, training, and debriefing. A dedicated optical sight is used for directing the radar's narrow beam onto the desired target area.

■ Avion Robotic Provides Information on their PHOENIX Tandem Rotor Heavy UAV

(mc) Norwegian Company Avion Robotic displayed a scale model of their developmental PHOENIX heavy UAV at the Helitech/DroneX exhibition. Jan Fosen, CEO of Avion Robotic provided further details of the PHOENIX's characteristics and the project's development timeline. The PHOENIX is in the heavy class of UAV, and is intended primarily for transportation. It uses a tandem rotor design, familiar to most as the rotor layout used by the CH-47 CHINOOK. When development is completed, the internal bay will be capable of accommodating four NATO standard pallets, with a payload weight limit of 1,000 kg, at an endurance of four hours.



Photo: Avion Robotic

Alternatively, the UAV can carry an underslung payload of 1,400 kg, although this reduces the endurance to two hours. The maximum range is estimated at 800 km, with a cruising speed of around 64 m/s (125 knots). Fosen explained that due to operating at these ranges, the UAV control and sensor output feed are reliant on satellite communications.

The company is also developing a folding wheel load bed for simplifying the loading and off-loading process from the internal bay, and the internal bay will also feature tie-down points for load fastening during transit.

The PHOENIX is presently in the pre-prototype stage of its development phase. Fosen stated that under the company's planned timetable, development of the prototype is scheduled for January 2023, with initial efforts focussed on development of the rotor system. The first flight and CS-27 certification are scheduled for 2024. The UAV is due to be ready for production in 2025.

Avion have partnered with another company to enter the PHOENIX for the Heavy Lift Challenge (HLC) Phase 2, run by the UK MoD's Defence Equipment and Support (DE&S) Future Capability Group (FCG) and the Royal Navy. HLC aims to test unmanned systems' potential for delivering supplies and equipment to ships or personnel out at sea. The goal is to find a means of being able to autonomously transport vital supplies to combat zones at low risk to personnel.

EXOCET FAMILY

LONG RANGE STRIKE CAPABILITY IN ALL ENVIRONMENTS
WITH A HIGH PROBABILITY OF INTERCEPT

MBDA
MISSILE SYSTEMS



SECURING
THE SKIES



PROTECTING
YOUR ASSETS





MASTERING
THE SEAS



COMMANDING
THE COMBAT ZONE



  mbda-systems.com

■ Ultra Electronics Appoints a New CEO

(mc) On 14 September 2022, UK-based firm Ultra Electronics announced the appointment of Carlo Zaffanella as the new President and CEO of Ultra Maritime, succeeding Thomas Link, effective 6 September 2022. Carlo joined Ultra from General Dynamics Mission Systems where he was General Manager of the Maritime and Strategic Systems line of business. Having spent 22 years at General Dynamics, Carlo has held various leadership roles, principally in the maritime marketplace.

■ Rheinmetall and Helsing Announce Strategic Partnership

(mc) On 15 September 2022, Rheinmetall announced that they had launched a strategic partnership with Helsing, a Euro-

Photo: Rheinmetall



pean provider of software and AI for defence systems. The partnership is aimed at improving the capabilities of Rheinmetall's land warfare product portfolio, through joint development of software for defence systems. Rheinmetall did not provide further details regarding the likely initial areas of focus for this partnership.

■ Northrop Grumman Opens New Assembly and Test Facility for Space Systems

(mc) On 19 September 2022, Northrop Grumman announced that it had opened

its Maryland Space Assembly and Test (MSAT) 2 facility at the company's Baltimore campus. The 5110 m² (55,000 square foot) facility provides a manufacturing, assembly and test hub to support the company's customer base in space payload and ground systems. The MSAT2 facility adds a progressive assembly line and testing capabilities to Northrop Grumman's Maryland Space Assembly and Test complex. A central feature is a new thermal vacuum chamber (TVAC) capable of simulating the harsh thermal conditions of space, allowing engineers to subject space payloads to extreme temperature variations to ensure their performance. The facility also includes digitally-driven robotic manufacturing line, with environmentally controlled clean rooms in the 10K and 100K class.

■ Kongsberg Digital appoints new CEO

On 6 September 2022, Kongsberg Digital announced that Shane McArdle (43) has been appointed the company's new CEO. McArdle will be Kongsberg Digital's second CEO following Hege Skryseth's departure for Equinor the previous week. McArdle was recruited for the position from his previous post as Head of Digital Energy at Kongsberg Digital.

■ American Rheinmetall Vehicles Signs Cooperative R&D Agreement with US Army's Combat Capabilities Development Command Ground Vehicle Systems Center

(mc) On 14 September 2022, Rheinmetall announced that their subsidiary American Rheinmetall Vehicles signed a Cooperative Research and Development Agreement (CRADA) with the US Army's Combat Capabilities Development Command Ground Vehicle Systems Center (DEVCOM GVSC). The agreement will allow American Rhein-

metall Vehicles and DEVCOM GVSC to collaborate on a regular basis to develop integrated combat vehicle suspension, track, and running gear technologies. It also provides an avenue for the two entities to explore integration of the US Army's Advanced Lightweight Track, along with other improvements in running gear systems and configurations, for the Optionally Manned Fighting Vehicle (OMFV) programme, and other vehicle modernisation programmes.

■ Elbit Systems Deutschland Appoint New CEO

Photo: Elbit Systems



Elbit Systems Deutschland GmbH & Co. KG have announced that Gregor Zowierucha was appointed the company's new CEO at the beginning of July 2022, succeeding

the long-time managing director Thomas Nützel, who is retiring.

Zowierucha first served as an officer in the Centre for Intelligence and, after his Afghanistan deployment, was assigned to posts in the German Embassy in Washington D.C., the Operations Command and the Federal Ministry of Defence. Subsequently, he has held various management positions within the German defence technology industry for many years, including at Rheinmetall and ESG in the Mission Aircraft and Unmanned Systems divisions.

■ Premium AEROTEC Undergoes Structural and Management Changes

(mc) On 31 August 2022, Premium AEROTEC announced changes to their company

Photo: Northrop Grumman



Photos: Premium AEROTEC



and management structures, following Airbus' new industrial set-up in the field of civil aircraft manufacturing in Germany coming into effect at the start of July.

As part of the restructuring of the aircraft business in Germany, Premium AEROTEC GmbH is now to be gradually transformed into a holding company in which Airbus' civil aircraft manufacturing activities in Germany will be bundled. The company has stated that under these plans, the business activities of the Premium AEROTEC sites in Augsburg, Varel and Braşov will be combined, as of 1 July 2022, and managed as a business unit called Premium AEROTEC Industry, operating under the umbrella of Premium AEROTEC GmbH.

This will be accompanied by a change in the management of Premium AEROTEC GmbH, with the following changes announced:

- Dr. Thomas Ehm (56) has resigned from his position as Chairman of the Management Board of Premium AEROTEC GmbH, effective 1 September 2022, but will continue to support the company in an advisory capacity until the end of the year.
- Dr. Sabine Klauke is the new Chairwoman of the Supervisory Board of Premium AEROTEC GmbH since July 1, 2022.
- Dr. André Walter (55), has been appointed Chairman of the Management Board of Airbus Aerostructures GmbH, effective September 1, 2022.
- Gerd Weber (49), has been appointed Chairman of the Management Board of Airbus Operations GmbH.
- Sebastian Peters (45) was appointed Head of the Business Unit "Premium AEROTEC Industry" business unit.
- Marco Wagner (53) was appointed as a new member of the Management Board and Labour Director of Premium AEROTEC GmbH, succeeding Frank Müller (54), who resigned as Managing Director on July 1.



- Frank Müller (54) will temporarily take over the operational management of the HR department at Premium AEROTEC Industry.

- Thorsten Fischer (53) was appointed Managing Director and Chief Financial

Officer of Premium AEROTEC at the end of June, taking the role in addition to his current position as Managing Director of Airbus Operations and Head of Operations Controlling Airbus. Fischer succeeds Alexander Thierer (47), who has been Head of Finance at Airbus Aerostructures since July 1.

In addition, according to a resolution of the Supervisory Board of Premium AEROTEC GmbH, the management of Premium AEROTEC's Romanian subsidiary, Premium AEROTEC SRL, will consist of Sebastian Peters and Joachim Nägele.

■ Northrop Grumman and Terma Sign Collaboration Agreement for Electronic Warfare Simulation in Europe

On 24 August 2022, Northrop Grumman announced that they had signed a Memorandum of Understanding (MoU) with Danish company Terma to cooperate on electronic warfare (EW) simulation and training opportunities in Northern Europe. Under the terms of the MoU, the companies will contribute their expertise to creating modern air operations training packages, combining Northrop Grumman's capabilities in digital environments with Terma's support of regional partners.

Northrop Grumman's simulation and training capabilities are designed to provide realistic EW combat training for pilots of fourth- and fifth- generation aircraft, and also to help train military personnel in identifying and countering enemy missile or artillery threats.

The Denmark-based Terma develops products and systems for defence and security applications. These include command and control systems, surveillance, security and naval radar systems, self-protection systems for aircraft, space technology, and aerostructures for the aircraft industry, including the F-35 LIGHTNING II program.

■ Markus Barner Appointed Managing Director at Kärcher Futuretech

(jh) Kärcher Futuretech now has a dual leadership, the company writes in a press release. On 1 July 2022, Markus Barner (left) was appointed as the second managing director alongside Thomas Popp, who has been leading the company since 2012. For Markus Barner, the new position closes a circle: he began his career at Kärcher Futuretech in 2007 as an assistant to the management.



Photo: Kärcher Futuretech

Markus Barner started his professional career at Kärcher in 2004. He has held various positions in Marketing, Sales and Product Management at both Kärcher and Kärcher Futuretech since 2007. In his last assignment as Authorised Signatory and Head of Sales and Marketing, he had already been part of the management of Kärcher Futuretech since 2015.

■ Nordic Unmanned Opens North American Office



Photo: Nordic Unmanned

On 22 August 2022, Nordic Unmanned announced the opening of their North America office, to be led by aviation, defence, rail, and transit executive Timothy Tenne. The office

will be located in Baltimore County, Maryland, close to strategic partners, potential governmental clients, commercial clients and aviation authorities. The new office's focus will be on offering Nordic Unmanned's existing products and services portfolio in North America, as well as operational experience with performing long-range, complex beyond visual line of sight (BVLOS) operations.

According to the company, North America is the largest drone market in the world, with the highest expected growth rate, within both the defence and enterprise markets. The 2023 US defence budget request consists of 20 programs dedicated to the procurement of drones, with a total combined value of US\$2.6 billion. The enterprise market adds significant potential value to this, with its expected compounded annual growth rate (CAGR) of 15.8% from 2021 to 2030.

Libya – Between Chaos and Uncertainty

Andreea Stoian Karadeli

The Libyan uprising followed the same pattern as the other revolutions of the Arab Spring, but it pushed the country into an opportunistic and consuming power vacuum, a vicious cycle of war, extremism, tribal competition, human rights abuses, and death. For more than a decade, Libya has been hanging between chaos and uncertainty, without any prospects for peace and stability.

Twelve years ago, countries in the Middle East and North Africa witnessed the first uprisings that would spread and become the Arab Spring. Marked by a common slogan – “the people want the regime to step down”, the unrest of the Arab world asked for change at any cost. But change never brought peace, stability, and democracy in the region. Instead, it pushed the region into a new vicious cycle of chaos and uncertainty, killing thousands and forcing many more to take refuge abroad. The uprising against the Libyan leader, Muammar Gaddafi, started by the same path as the other Arab uprisings, degenerating into an opportunistic and consuming power vacuum. Internal rivalries have been fuelled by further external influences of competing foreign actors that engaged in the local conflict, playing their own cards in a game that brought no gain to the Libyan people.

At the end of August 2022, The UN Security Council discussed the ongoing stalemate and continued delays in implementing the electoral process in Libya, reflected by increasing violence among rival groups and posing a growing threat to security in and around Tripoli, and potentially beyond the Libyan borders. However, it is hard to say whether there is any real interest in solving the conflict, within the country and among the foreign actors involved in the war. And this

Photo: Senior Airman Joel Pfister/USAF



A crew chief at Whiteman Air Force Base, Montana, marshals in a B-2 Spirit stealth bomber on 19 January 2017. Two B-2 Spirit stealth bombers returned after flying an approximate 30-hour sortie in support of operations near Sirte, Libya.

has been reflected in the evolution of the conflict since the death of Muammar Gaddafi and, at the same time, it can be easily noticed in the current context on the ground where violence has become ‘business as usual’ at the cost of the local population. While the focus of the international community has been shifted to Russia’s invasion of Ukraine and the resulting energy crisis, Libya’s cyclic civil war gets more alarming each day, threatening to affect countries of the Mediterranean and North Africa. Therefore, it is hard not to wonder what the future will bring for a country whose destiny seems to be marked by a spring that turned into a never-ending winter dictated by internal and external rivalries.

The “Libyan Spring” – a Never-Ending Winter

The Arab Spring reached Libya in February 2011, with the first uprisings starting in Benghazi, spreading to other cities

across the country and leading to clashes between Gaddafi’s security forces and the opposition. In less than a month, the UN Security Council announced its decision to establish a no-fly zone over the country and airstrikes to protect civilians started under NATO’s command. In July 2011, the National Transitional Council (NTC) was formally recognised internationally as the legitimate government in the country, and the increasing anti-Gaddafi rebellions forced the former ruler to leave the capital and hide. Eight months after the first protests started, on October 20, Muammar Gaddafi was captured and killed when the opposition took control over Sirte. In the aftermath of Gaddafi’s killing, NTC declared Libya as a ‘liberated’ country and announced its plans to hold elections within 8 months. Eleven years have passed and the so-called ‘liberated’ country has already witnessed several rounds of civil war, paying the price for a change that never came. There is a karmic symbolism in the kill-

Author

Dr Andreea Stoian Karadeli is an independent researcher based in Turkey, an Associate Fellow at the Geneva Centre for Security Policy and a Visiting Researcher at the University of South Wales. Her interdisciplinary research varies from cultural and intercultural studies to conflict resolution and focusses on national security and terrorism, with a specific expertise in the Middle East.

ing of a leader by his own people. A symbolism that can only be noticed and understood by the ones that come from a nation who, at some point in history, turned against their leader. Videos with Gaddafi's last moments were spread over the internet, showing a shadow of the former Libyan ruler, marked by blood, fear and hatred. Unfortunately, his death was not followed by peace, security, and stability, but, instead, the country became a perfect reflection of the ruler's humiliating death. Violence and opportunistic extremist groups spread along the Libyan territory. In 2012, the US ambassador along with three US citizens were killed by extremist militants in Benghazi. A year later, in 2013, a blockade on oil exports was undertaken by the Petroleum Facilities Guard militia.

What started as a call for democratic change, that could provide equality, democratic rights, and a democratic elected government, turned into a civil war that was kept alive by several failed transitional governments, regional and foreign interference, hunger, and death. The North African country became divided between two rival administrations in the years after the overthrow of former leader Muammar Gaddafi a decade ago. The Government of National Accord (GNA) is based in the capital, Tripoli, located in the west, while the Libyan National Army (LNA) is in the east. Warlord Khalifa Haftar and his so-called military has attacked in several rounds Tripoli and the UN-backed, internationally-recognised Government of National Accord. Today's failure to unify the divided Libyan nation is also rooted in the strategic policy followed by the formal regime who cemented both tribal and regional identities through selective recruitment into the security sector, causing split between East and West. This policy resulted in the form of 'enemy' governments based in Tripoli in the West and in Tobruk in the East, near the border with Egypt.

The 'Libyan Spring' turned into a never-ending winter, governed by chaos, unrest, and a geographical, political, and ideological split between East and West. Since the start of the civil war in 2014, the Libyan struggle has turned from a rudimentary conflict, marked by the typical Salafi-Jihadi nuances of the post-Arab Spring power vacuum, into a highly sophisticated multinational conflict, becoming the first totally privatised armed conflict in contemporary history. Local rivalries have been deepened by an international rivalry for the future of Libya, its people and wealth.



Photo: USAID

All hands pull together when heavy oil field equipment must be moved to a new location.

Libya Today

The Libyan unrest has never stopped, neither has it achieved the initial goal of a democratic country, expected to provide equality, democracy, peace, and stability. This year, the end of August brought further clashes between the two main local sides of the Libyan war, reflecting the limited political progress that was achieved. On top of this, there is still no consensus on a constitutional framework for the elections. The human rights situation in the country continues to be a concern, with reports of abuses coming in every month from several organisations active on the ground.

UN political affairs chief Rosemary DiCarlo brought to the attention of the UN Security Council that Tripoli was just recently, once again, the theatre of violent clashes between armed groups supporting either the incumbent Prime Minister, Abdul Hamid Dbeibah, or his rival Fathi Bashagha, who was appointed Prime Minister by the parliament in the east. One of the most recent violent conflicts broke out in the early hours of 27 August and rapidly intensified and spread to civilian-populated areas of Tripoli. According to UN reports, the fight involved the indiscriminate use of medium and heavy weapons, affecting civilians and civilian infrastructure. This



Photo: Senior Airman Joel Pfeister/USAF

Brig. Gen. Paul W. Tibbets IV, the 509th Bomb Wing commander, welcomes home two B-2 Spirit stealth bomber pilots at Whiteman Air Force Base, Montana on 19 January 2017.

appeared to be attempt of pro-Bashaga forces to enter the capital from the east. However, they were blocked by pro-Dbeibah forces at Zleiten – about 160 km east of Tripoli, and were forced to retreat, following clashes. Attempts by other pro-Bashaga armed groups to advance on the capital from the west and southwest were similarly repelled. The Libyan authorities released an official declaration, estimating that a total of 42 people were killed, including four civilians, while 159 were injured in the clashes. Fifty families were reportedly displaced, and five health facilities were significantly damaged. Two deten-

year, after a three-month shut-down, oil production resumed in July, but it could close again due to public discontent in the south over lack of basic resources and poor living conditions.

In the shadow of Syria and, most recently, Ukraine, Libya's winter is far from coming to an end. On the ground, and beyond its borders, security dynamics go hand in hand with the economic ones. Violence and chaos provide an opportunity for profitable, but short-handed political and economic gains, while the heaviest price is paid, once again, by the local population who are played as pawns by each side.

to delegate power to local participants to overcome regional rivalries. This can only be achieved by developing a complex, historical, community-based, and context-oriented understanding of the local dynamics. Unfortunately, recent global events have dispersed the interest of the international community and the active regional powers to new international crises, such as the ongoing Russia-Ukraine war, materialising further security issues.

Adopting a pragmatic and opportunistic perspective to the relation of the two separate, but equally interrelated wars, Russia's invasion of Ukraine and the current crisis can provide a series of options for Libya. At the ground combat level, the new war in eastern Europe pushed for a migration of Russia's affiliated mercenaries from the Libyan grounds to Ukrainian ones. While this should have represented an opportunity for the government to gain control of local militia and push for the unification of military forces, the interests of the political elite within the country fuelled further internal fighting, hindering Libya's potential to seize the momentum.

Still, there is one more opportunity arising from the current energy crisis faced by the European countries due to the Russia-Ukraine war – the supply of hydrocarbons. Bearing in mind Libya's high volume, proven reserves, and product quality, together with its proximity to the southern shores of Europe, the country could play a key strategic role in providing the best solution for alternative sources for crude oil and natural gas. Nevertheless, the fighting between the two interim governments, together with the public discontent in the South over a lack of basic resources, poor living conditions that cause irregular oil production, the lack of budget, and disrupted decision-making minimises the potential and reliability of Libya as a possible main energy supplier to Europe.

Lost in the rivalries of their own community leaders, paying the karmic price for the death of their formal leader, Libyans never lost their hope for a better future that will eventually bring what they have fought for ever since the first uprising in Benghazi. The US Special Envoy previously noted that holding elections is the best way out of the current political stalemate in Libya. However, holding parliamentary and presidential elections, under the current conflicts, and without a well-drafted peace agreement, is far from representing a solution to end the Libyan winter, proving once more, that we fail to understand the reality on the ground. ■



Photo: Sgt. Ryan Young/USMC

US Marines with 22nd Marine Expeditionary Unit (MEU) prepare an AH-1W Super Cobra for flight aboard the amphibious transport dock ship USS San Antonio (LPD 17) in support of Operation Odyssey Lightning (OOL), 8 November 2016

tion centres for migrants and refugees were affected, involving a total of 560 persons. All these numbers reflect the consequences of just one fight.

Together with the internal violent rivalry between the two main local sides of the Libyan war, the international consensus is lacking, partly due to geopolitical competition between nations such as France and Italy, each of which has a completely different way of tactical thinking when it comes to the crisis in Libya. Moreover, frequent oil production halts while lack of oil fields maintenance has cost the country billions of dollars in revenues. This

The European Crisis – a Libyan Opportunity?

Predicting the future of any country, in the current global context, is an impossible task, even if we consider history's famous cyclicity. Many argue that the path to democracy might be different from country to country and, in the most difficult cases, it can ask for the highest price in exchange for freedom. To begin with, Libya needs a peace agreement that promotes a new system of power sharing, based on substantial decentralisation, providing the opportunity



EXPERIENCE
LIFE'S EACH MOMENT IN
SAFETY & TRUST

EURONAVAL
18 - 21 OCTOBER, 2022
BOOTH NO: B37



www.aselsan.com

aselsan

TECHNOLOGY SERVING PEOPLE & PLANET

Learning from Recent Wars

Observations from the Second Nagorno-Karabakh War and the Russian-Ukrainian War

John Antal

Success in future conflicts depends on the ability to analyse the trends found in today's wars. By examining the Second Nagorno-Karabakh War, and the ongoing Russian-Ukrainian War, we can gain valuable insights concerning the methods of warfare. The following observations provide insights that can help leaders prepare for future threats.

On 24 February 2022, the Russians miscalculated the nature of the war they unleashed on Ukraine. They expected and planned for a quick victory. NATO also failed to understand that the Ukrainians would fight. When the US offered to evacuate Ukrainian President Volodymyr Zelensky from Kiev on 26 February 2022, Zelensky's reply, "I don't need a ride, I need more ammunition," electrified and rallied his nation. Russia's intent appeared to be to stun the Ukrainians with short but fierce missile strikes and then overrun them in a lightning assault.

Photo: Ministry of Internal Affairs of Ukraine



This Russian tank with roof bar-armour was damaged by Ukrainian troops in Mariupol, Ukraine in March 2022. The bar armour was installed in an attempt to protect tanks from top-attack munitions. According to the ORYX open-source intelligence website, Russia has lost 5,362 vehicles, of which 3,481 were destroyed, 129 damaged, 301 abandoned, and 1451 captured. This total includes nearly 1,000 tanks.

Understand Your Enemy

Rosgvardia, Russia's internal-security police forces, raced ahead of several of the attack columns to accept the surrender of Ukrainian officials only to be ambushed by Ukrainian forces. Based on their incorrect assumption of an easy and quick war, the Russians attacked with unfavourable force ratios against a nation that rapidly mobilised to repel them. The initial Russian onslaught involved nearly 110 Battalion Tactical Groups (BTGs), comprising approximately 142,000 soldiers, against a Ukrainian population of over five million. The first phase of the invasion (24 February to 28 April 2022) was cata-

strophic for Russia. Endemic, internal corruption highlighted Russia's inability to "know themselves", resulting in them overestimating the capabilities of their own forces. Prior to the invasion, Russian troops sold vital fuel for cash, were issued expired rations, and operated trucks with tires that quickly deflated or rotted away. The AZART P-187 digital software-defined radios (SDR) used in the first weeks of the invasion, an essential tool to synchronize combined arms operations, did not work as they had been intentionally assembled with inferior parts. Unable to coordinate their forces with secure communications, Russian commanders resorted to using mobile phones. Ukraine easily identified and targeted these. The false assumption of a quick triumph, and the widespread corruption of the full Russian military apparatus, surely provides implications for Communist China as they contemplate the use of military force against Taiwan.

First Strike

Today, ubiquitous sensors can detect almost everything in the battlespace and long-range precision fires (LRPF) and drones can quickly capitalise on these capabilities to destroy high value targets (HVT). The "first strike" advantage is the ability of an attacker to paralyze an enemy in the first hours and days of a war. A surprise first strike that destroys the most critical targets, if executed with overwhelming force, can be decisive. The Azerbaijanis achieved this in the first weeks of the Second Nagorno-Karabakh War. The Russians did not maximize the first strike advantage when they invaded Ukraine. On 10 March 2022, Russian Defence Ministry spokesperson Igor Konashenkov said that Russia destroyed approximately 2,911 Ukrainian military facilities. Even if this number was accurate and not propaganda, it was insufficient to cripp-

Author

John Antal is a defence analyst and correspondent who has served as a member of the US Army Science Board. He retired from the US Army after 30-years in uniform. John has appeared on radio, podcast, and television shows to discuss military topics and is the author of 16 books and hundreds of magazine articles on military and leadership subjects.

ple Ukrainian defences. Despite hundreds of Russian artillery, missile, and air strikes in the war's first week, Russian LRP attacks were inadequate for the scale and depth of the battlespace. Key targets, such as Ukraine's internet service and communications capabilities, were degraded, but in two weeks, were back in operation thanks to American entrepreneur Elon Musk who provided Ukraine with his Starlink internet service. The Russians failed to eliminate other HVTs, such as the capture or killing of President Zelensky and the reduction of key Ukrainian government facilities and headquarters. Instead of decapitating the enemy and forcing an immediate surrender, the Russians only stiffened their resolve and resistance. One can be certain that the Chinese are studying this "first strike failure" closely and would undoubtedly plan for an overwhelming first strike to capture Taiwan.

Logistics

In the Second Nagorno-Karabakh War, the Azerbaijanis outnumbered, outmatched, and outfought their Armenian adversaries. They supported their military forces with enough logistical support to sustain the fight for 44 days. Had the war lasted into the



Photo: US Air Force

US and other NATO nations supply Ukraine with much needed logistical support. A C-17 Globemaster III assigned to the Air Mobility Command prepares Guided Multiple Launch Rocket System munitions at Joint Base McGuire-Dix-Lakehurst, N.J., 13 August 2022. The munitions cargo is part of an additional security assistance package for Ukraine.

winter, Azerbaijan would have experienced logistical shortages. They recognised they had to win before the mountains were deep in snow. The Russians attacked Ukraine with too small a force, along multiple, disparate axes of advance, with woefully inadequate resupply of ammunition, fuel, food, spare parts and more. It was a logistical planning failure that still plagues the Russian forces seven months into the conflict.

Masking

The greatest lesson of both the Second Nagorno-Karabakh War and the Russian-Ukrainian War is masking. Masking is the full-spectrum, multi-domain effort to deceive enemy sensors and disrupt enemy targeting. Today's battlespace is transparent, with optical, thermal, electronic, acoustic, and quantum sensors operating in all do-



Sensitive data won't become common knowledge.

SINA protects the data and IT of the armed forces up to SECRET and NATO SECRET. Highly scalable, resilient, flexible.

When it comes to safeguarding national security, secunet is ready to help. As IT security partner to the German federal government, we supply multi-level security and high-security encryption technology solutions.

secunet.com/en/defence protecting digital infrastructures

secunet



Photo: US Marine Corps / Sarah Pysker

The US is providing SWITCHBLADE Loitering Munitions (LMs) to Ukraine. In this photo, a US Marine launches a SWITCHBLADE LM during a training exercise in North Carolina in 2021.

mains — land, sea, air, space and cyber. Against a technologically equipped peer competitor, it is nearly impossible to hide. In the Second Nagorno-Karabakh War, Azerbaijan had multi-domain sensors that uncovered Armenia's forces. Azerbaijan enjoyed tremendous assistance from Turkey, while Armenia received little support from Russia. In the Russian-Ukrainian War, both Russian and Ukrainian forces have access to sophisticated sensor networks. Russia has a robust satellite imagery capability, as well as aircraft, unmanned aerial systems, and ground-based sensors. The US and NATO are providing Ukraine with arguably the best targeting-sensor data in the world. Multiple sensors identify command posts (CPs), ammunition dumps, fuel depots, and other HVTs. Precision attacks against these HVTs occur nearly every day in Ukraine. In April, an article in *Forbes Magazine* reported that Russia had lost over 31 CPs, with many senior leaders killed in these strikes. Although the Ukrainian HVT losses have not been as openly reported, their losses are also high. The inability to mask and deceive enemy sensors, coupled with the inability to disrupt the enemy's kill-chain to foil precision strikes, has resulted in stagnation, with both sides nearing exhaustion. In today's battlespace, the lesson is simple: mask or die.

Top Attack and Long-Range Precision Fires (LRPF)

In both the Second Nagorno-Karabakh War and the Russian-Ukrainian War, top attack by precision weapons has become the pre-

ferred method of attack. The thickness of the front glacis of a tank is much less important today than the tank's ability to mask and avoid top-attack systems. In both conflicts, the range of LRPF systems is the entire battlespace. Azerbaijan struck throughout the depth of the disputed Nagorno-Karabakh region and Russia has attacked across the width and breadth of Ukraine. In turn, Ukraine has also shown its ability to reach into Russian occupied Crimea. In modern warfare, there are no sanctuaries.

Urban War

Cities are a vital nexus of military, political, and economic infrastructure and hold 57% of the world's human population. City fighting cannot be avoided. It is difficult, risky, requires significant military manpower, and consequently, results in often horrendous casualty rates. As cities expand geographically, this problem multiplies. As an example, Kyiv occupies 839 square kilometres and had a pre-war population of 3.5 million. Assuming a quarter of Kyiv's inhabitants would serve as combatants, to defeat a stout, urban defence of the city, Russia should have committed a minimum of five times the numbers of attackers to defenders, or approximately 875,000 Russian troops. US Army doctrine proposes an even greater ratio of 6:1 in analogous offensive operations against defended urban targets. Numbers matter. There is an inflection point where weapon system technology cannot compensate for large quantities of ground troops. Attacking Ukraine, with a population of 39 million, with an army of less than 200,000, was sheer hubris. In addition, urban combat is incredibly destructive, as the major city fights of WWII and more recent conflicts testify. Ukrainian cities have been the scenes of massive, close-quarters fighting in the rubble of their battered buildings and infrastructure; truly deadly work for the combatants on both sides. The debris of broken buildings often aids the defender by blocking access to roads and offering ready-made defensive works. Fighting in the urban battlespace adds a complexity that defies conventional warfighting methods. New tactics, techniques, procedures and technologies for urban combat are essential. China would be faced with this daunting challenge should they attempt to capture Taipei with expeditionary forces, transported across the straits of Taiwan from mainland China against well-trained, motivated and prepared Taiwanese defence forces.

Unmanned Warfare

Unmanned systems have come of age. The clever use of Loitering Munitions (LMs)

and Unmanned Combat Aerial Vehicles (UCAVs) generated a significant advantage for Azerbaijan during the Second Nagorno-Karabakh War. Both Russia and Ukraine have extensively used LMs and UCAVs during their ongoing conflict. Ukraine's use of UCAVs, such as the BAYRAKTAR TB2, made spectacular attacks on land and in the Black Sea. The decisive use of robotic systems in this conflict, however, is elusive. The scale of the war in Ukraine, compared to the 2020 Nagorno-Karabakh War, has proven that LMs and UCAVs are valuable tools, but the piecemeal use of these systems will not dominate the battlespace. If organized in mass and employed in a combined arms effort to establish a "persistent, precision fires strike zone" over a designated area of the battlespace, they will create the conditions for a breakthrough. Until then, robotic systems are an invaluable enabler, but not yet a decisive weapon.

Leadership Losses

With CPs hunted as HVTs in both the Second Nagorno-Karabakh War and the Russian-Ukrainian War, commanding and controlling (C2) military forces from large, fixed command posts is both antiquated and extremely risky. The Russians employ a top-down, tight-rein command style, which is additionally hampered by the lack of a professional non-commissioned officer corps. In the Russian Army, leadership rests solely with the officers and casualties among Russian officers have been extraordinary. A *Newsweek* article on 8 August 2022 reported that, since the beginning of the invasion, the Ukrainians have killed 99 Russian colonels and lieutenant colonels, and possibly 14 generals. This serves to explain the poor combat performance of many Russian units. It takes at least a year to train a junior officer, years to train majors and colonels, and decades to train generals. Losing so many leaders in the space of just six months is a tremendous disruption of Russian combat leadership and unit cohesion. Unlike many weapon systems, leadership losses such as these are very difficult to replace, especially in the short term. China's People's Liberation Army, which shares the same top-down style of command, and nominal combat experience, could suffer a similar fate if they chose to engage a potent foe such as Taiwan. These few striking observations from the Nagorno-Karabakh War and the Russian-Ukraine war should serve as a warning for both US and NATO forces as they prepare for the coming storm. ■

Is a Europe post-NATO Still Possible?

Giulia Tilenni

The war in Ukraine brutally put military issues at the top of EU countries' agendas again, boosting European defence budgets after more than a decade of under-investment. In a scenario that might seem ideal for affirming autonomous EU defence cooperation, NATO and the US will instead likely be the big winners.

In a long interview given to *The Economist* in 2019, French President Macron said that "what we are currently experiencing is the brain death of NATO". Until 2022, the scenario he described appeared relatively close to reality.

Russia was somehow perceived as less of a threat despite the annexation of Crimea in 2014, thus depriving the Alliance of its historical enemy. Since his 2016 election, President Trump harshly criticised NATO and its European members. Indeed, he considered that the US should no longer act as the "world policeman", and that US funding to the Alliance was too high compared to European contributions. In particular, he pointed to the inability of most members to meet the NATO goal of spending 2% of GDP in defence, as agreed in 2014. Moreover, Trump mainly followed a domestic agenda during his Presidency, with the notable exception of the commercial war with China. The arrival of President Biden in 2020 reassured Allies concerning reliability but did not bring substantial changes in Washington's political focus, at least for the first year. Additionally, the hasty withdrawal from Afghanistan, which constituted the bulk of NATO's military missions, seemed to bring the organisation's purpose into question.

However, the destiny of the organisation has radically changed on 24 February 2022, with the Russian invasion of Ukraine. The first conflict waged in Europe and involving a nuclear power since the end of the Cold War has suddenly revived NATO, which has regained its original scope with the return of its historical enemy. The crisis has also demonstrated that the EU is far from being ready to have an autonomous defence policy, despite years of work.

Author

Giulia Tilenni is an international affairs analyst based in Paris, France.



Photo: NATO

A US Army M777 Howitzer artillery gun fires during an exercise at Smârdan Training Area in Romania, on 8 March 2022. The US Army has deployed several regiments to Romania since February 2022 in response to Russia's aggression towards Ukraine.

EU Efforts to Gain Autonomy

European cooperative efforts have strongly increased in recent years, mainly driven by France, for whom strategic autonomy from the US is a mantra.

Since 2018, the Capability Development Plan (CDP) has been in place to prioritise military capabilities that need to be commonly addressed and developed. The Permanent Structured Cooperation (PESCO) and/or the European Defence Fund (EDF) provide a legal framework and specific funds for the development of joint capabilities. About 60 programmes have been launched under PESCO in the last few years, while requests for proposals to receive EDF funding are multiplying.

This dynamic is interesting, insofar as it reaffirms the political willingness to cooperate, however its impact has been limited so far, mainly due to the bottom-up approach taken. Groups of companies and states put projects forward, mainly driven by the

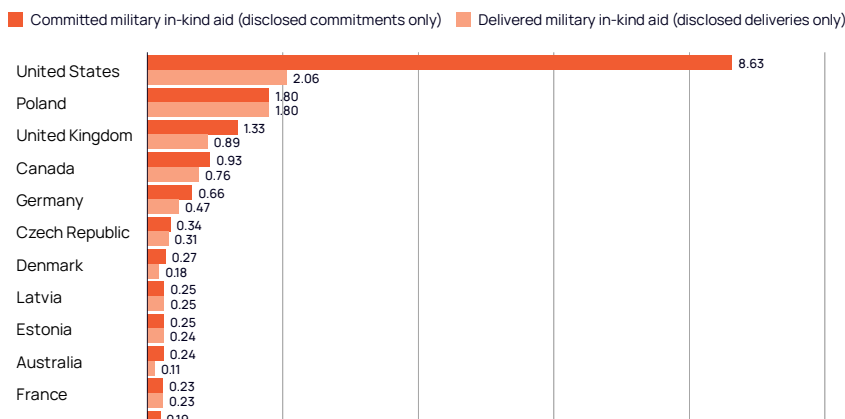
possibility of using EU funding for various national purposes, from the preservation of occupational levels to the requirements of national armed forces, to serving national foreign policy objectives.

Programmatic documents identifying common EU objectives – a crucial precondition for a common defence policy – do exist in theory. In the founding strategic documents of the most recent cooperative efforts, the 2016 Global Strategy and the 2022 Strategic Compass, the EU clearly affirms the willingness to step up its international ambitions.

However, the documents' role within relevant international organisations, in particular NATO, remains unclear. While reaffirming the need for an EU defence policy to serve an EU agenda, the two documents nonetheless recognise the importance of NATO for EU defence. A comparison of the two texts suggests that the EU's willingness for developing an EU pillar within NATO was stronger in

Government support to Ukraine: Committed vs. delivered weapons, € billion

Commitments Jan. 24 to Aug. 3, 2022. Data on 40 donor countries; scroll to see more countries



Quelle: Antezza et al. (2022) "The Ukraine Support Tracker" Kiel WP

ifw-kiel.de/ukrainetracker

Graphics: ifw Kiel

2016 than in 2022. Both documents stress that synergies should be built on the full respect of the institutional frameworks and the "decision-making autonomy" of the two organisations. However, the 2016 version clearly states that "[...] the EU needs to be strengthened as a security community: European security and defence efforts should enable the EU to act autonomously while also contributing to and undertaking actions in cooperation with NATO. A more credible European defence is essential also for the sake of a healthy transatlantic partnership with the United States." On the other hand, the 2022 Strategic Compass states that "The EU will also help to strengthen NATO and become a stronger Transatlantic partner: a partner that is more capable of sharing the burden of maintaining international peace and security". In the following line, the document, approved in March 2022, also adds that "Russia's aggression against Ukraine has shown both how essential NATO is for the collective defence of its members and the important role that the EU plays in today's complex security and defence environment".

As will be discussed further, the war in Ukraine has been a gamechanger for both NATO and the EU.

The War in Ukraine

Six months after its beginning, the war seems far from over, and its likely outcome remains unclear. Russia failed to meet its original objective of a rapid invasion of the country, in part because it underestimated Ukrainian resistance. As we write, the conflict is evolving towards a war of attrition, in which the risk of nuclear incident remains high due to skirmishes around the Zapor-

izhzhia nuclear power plant (NPP). The War in Ukraine has served as a notable example of why a post-NATO EU is still far from being achievable.

As already mentioned, the EU has been working on reinforcing defence collaborations for years. The first cooperative R&D projects have been launched, thanks to the first investments under different defence-related funds. A brand-new strategic framework is in place, and political consensus regarding the need for a "geopolitical" EU is probably at a record high level. A war at the gates of Europe could have been the perfect occasion to demonstrate the progress the EU has made on foreign policy and defence. From a political perspective, EU countries succeeded in showing unity against

Russia. They were able to rapidly approve a significant package of sanctions, welcome Ukrainian refugees in Europe thanks to the first ever activation of the Temporary Protection Directive, and to approve assistance measures under the European Peace Facility (EPF). The total amount of assistance has reached EUR 2 billion since the start of the war, of which EUR 490 million was for "military equipment designed to deliver lethal force for defensive purposes" and EUR 10 million to "cover the provision of equipment and supplies, such as personal protective equipment, first aid kits, and fuel".

In relative terms, these provisions represent an unprecedented EU effort, as significant military aid was approved, and more quickly than usual. In absolute terms, however, the EU is progressing too slowly, and its aid is less effective compared to what the other stakeholders have delivered, thus having a limited military impact on the battlefield. Given that battlefield equipment is very high on Ukraine's list of priorities, this

In particular, EU countries are struggling to pledge promised armaments, mainly due to their relative lack of excess equipment in storage. For some Western European countries, in particular Germany, sending weapons to Ukraine means accepting a shortage in specific systems. This is a dangerous situation, as self-defence capabilities must be preserved considering the war is ongoing and could escalate further.

According to the "Ukraine support tracker" from the Kiel institute for the world

Photo: NATO



NATO Secretary General Jens Stoltenberg and the President of the European Commission, Ursula von der Leyen at one of their frequent meetings, here in December 2020. Despite years of work, the EU is far from being ready to have an autonomous defence policy.

economy, the “gap between committed and disbursed aid has narrowed” for large EU countries between January and August 2022. To take some examples, Poland has already delivered the promised EUR 1.8 billion in equipment, while Germany has delivered only EUR 290 million out of the promised EUR 620 million. In the reference period, EU institutions (including Commission, Council and EPF, but also Macro-Financial Assistance and the European Investment Bank) pledged EUR 12.3 billion in financial aid and EUR 2.5 billion in military aid.

Why are these figures relevant to assess whether an EU defence may exist outside NATO? Because, in the same period, the US pledged EUR 10.3 billion in financial aid and EUR 25 billion in military aid, greatly exceeding the EU's figures. On 24 August, President Biden announced an additional package of about EUR 3 billion, the largest since the beginning of the war. For its part, the UK has pledged EUR 2.1 billion in financial aid and EUR 4 billion in military aid, and has delivered nearly all the weapons systems it had committed to.

Taken together, the combined US and UK packages are much larger than the EU package, but also provide more support for Ukraine on the battlefield. The US weapons systems delivered, which include about 20 US High Mobility Artillery Rocket Systems (HIMARS), UAVs and other artillery systems, are having a more important impact than the 18 CAESAR self-propelled howitzers (SPHs) pledged by France or the PANZERHAUBITZE 2000 (PZH 2000) that Germany sent in July as its first delivery of heavy weapons since the beginning of the war.

Further Reasons Why a Post-NATO EU is Unlikely

A further obstacle to the development of an EU autonomous defence outside NATO is the need for the US nuclear umbrella. Following Brexit, France remains the only EU country possessing nuclear capabilities. Per the conditions set in 2009, when the country reintegrated into the Alliance's command structure, the French nuclear deterrence is fully autonomous from NATO. Paris' doctrine is based on the principle of strict sufficiency (“stricte suffisance”): the nuclear arsenal must have the lowest size allowing for maintaining a credible deterrent and protecting national security. The nuclear force will be used to inflict unacceptable damages to the enemy's centres of power, in case of state-sponsored aggression

against French vital interests, wherever it comes from, and in whatever form.

The assessment of these interests, as well as the final decision on whether using nuclear weapons, lies fully in the hands of the French President. This situation makes sharing the French nuclear umbrella with EU countries simply impossible, due to differences in foreign policy objectives. Having the French President decide to use nuclear weapons to protect Lithuania or Greece, but only after the approval of EU institutions and 26 national Parliaments could only be the scenario for a fiction novel.

Moreover, the war in Ukraine finally convinced Finland and Sweden, who have been strong backers of EU defence so far, of the immediate need to join NATO to ensure their safety. With 23 out of the 27 EU members to be NATO members in the near future, and the war in Ukraine demonstrating the harm that years of under-investments had on the defence sector, the EU should finally abandon the idea of autonomous defence.

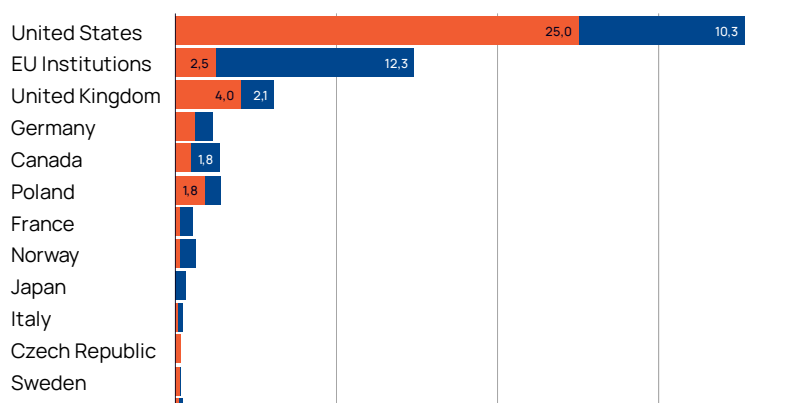
However, it might still be in a good position to create an EU pillar within NATO. To be successful, EU countries should effectively keep their promises in terms of

Government support to Ukraine: Type of assistance, € billion

Commitments Jan. 24 to Aug. 3, 2022. Data on 41 donors ; scroll to see more donors

■ Military ■ Financial

Select the type of aid ▼



Source: Antezza et al. (2022) “The Ukraine Support Tracker” Kiel WP

ifw-kiel.de/ukrainetracker

Graphics: ifw Kiel

As previously alluded to, the long-lasting and complex decision-making process is another main obstacle for taking meaningful foreign policy or military decisions. For instance, the EU has plenty of experience in military training missions, with 17 presently ongoing. However, EU defence ministers launched discussions on joint training mission for Ukrainian soldiers at the end of August, by which point British special forces had already trained 2500 out of the 10000 soldiers they had planned for.

Final Remarks

The war in Ukraine demonstrates that the US, and thus NATO, remain crucial for protecting EU security. The conflict has not only given new impetus to the Alliance but has shown the extent to which the EU is not prepared to autonomously protect its interests. The progress made so far on EU defence are big steps only from a European perspective, and in reality have had minimal military impact.

increased defence budget, to maintain a constant production pace of defence materiel and to always have enough ready systems in their inventories.

The ongoing EU initiatives remain interesting, but their impact is limited. To really try to have a say within NATO, EU countries should at least establish specific, broadly shared, and consistent foreign policy objectives, as well as a prompt decision-making process and effective domestic military capabilities. So far, EU countries' most recent attempt to counterbalance US decisions within NATO has failed. During the draft of the new Strategic concept, they were unable to impose the definition of China as “an economic competitor and a systemic rival”, which would have mirrored the one adopted in programmatic documents. Instead, Washington's view of China as a challenge to “interests, security, and values,” was approved, thus marking the importance of the US' pivot to Asia for the Alliance's agenda. This was a clear sign that an EU pillar within NATO remains far from fait accompli.

We will do our Utmost to Use Taxpayers' Money Well and Efficiently

Photo: Bundeswehr



In response to the Russian invasion of Ukraine, the German Armed Forces are to be modernised after decades of neglect. In an interview with ESD magazine, Defence Minister Christine Lambrecht explains her intentions for the German Bundeswehr.

ESD: In June 2022, three summits focused on the security situation in Europe and the world following Putin's attack on Ukraine. After these summits, is the West sufficiently well positioned to prevent Ukraine from losing the war?

Lambrecht: The West has shown impressive unity at all the summits. Especially with the "New Force Model" agreed in Madrid, it should be clear to the Russian aggressors that NATO is making forces available here on a completely new scale and with a high level of responsiveness.

We are continuing to support Ukraine with weapons and training in an internationally coordinated manner. That is why these international meetings are so important. Examples are the coordinated deliveries of howitzers together with the Netherlands and the deliveries of multiple rocket launchers jointly with the United Kingdom and the United States. This is a policy that we will continue to pursue.

ESD: At the Madrid summit, NATO also outlined specific demands for its member countries. What does that mean for the Bundeswehr? In which areas does the Bundeswehr have to take additional steps, or what additional requirements will it have to meet?

Lambrecht: Germany will participate in NATO's new Force Model. This involves a mechanised division with two combat brigades, a total of about 15,000 soldiers. In addition, NATO will be provided with up

to 65 aircraft and 20 naval units and other support units and formations. In 2025, we will introduce the new Force Model with NATO.

ESD: Does the Bundeswehr need structural changes in order to be able to cope with the changed priorities set by NATO and the EU?

Lambrecht: With the establishment of the Territorial Command, we have already made an important structural decision. In the Army, there will be reorganisations to increase unit readiness for Cold Start.

In general, we are working on structures where this is necessary. However, we are also trying to avoid unnecessary reorganisations. A structure that will not be fully operational for several years will not help us in the current situation. The goal is to strengthen the force so that it can act quickly and boldly when needed. Only when that is guaranteed will I address structural issues.

ESD: Is an even closer cooperation and integration of Europe's armed forces necessary for the fulfillment of tasks and how far should or could an integration of European armed forces go in this decade?

Lambrecht: Stronger European integration is not only important, but necessary. With the Procurement Acceleration Act, we are very consciously strengthening the possibilities for European armaments cooperation. At the troop level, we have very

good experience with integration at unit level with France, the Netherlands and the UK. The soldiers do not have to first learn about integration; it is now part of everyday military life. Decisions at the political level are important and good; we can't do without them. But we will only reach our goal when we tackle the practical side of things collectively.

ESD: In the event of a potential conflict, Germany is no longer a frontline state as it was during the Cold War, but a hub for the transfer of troops and materiel to the potential crisis area. Overall, is Germany prepared for this, both militarily and in terms of the necessary civilian resources?

Lambrecht: There has been considerable progress here. The Territorial Command already mentioned is also pooling tasks and responsibilities in this regard. Cooperation with civilian agencies is also becoming better organised, partly as a result of the experience gained from the pandemic and flood relief.

However, we must not stop critically analysing the State's overall resilience. For years, it was fashionable to outsource and even dispense with State capabilities. It is now worthwhile regaining such capabilities. We are taking this approach for the Bundeswehr, for example, with regard to the operational readiness of the Navy: We acquired the MV Werft Rostock shipyard in order to regain the ability to operate independently. This is an example from the

maintenance sector, but perhaps it is a model for other civilian areas as well.

ESD: The EUR 100 billion special allowance for the German Armed Forces and the increase in the federal budget have been conceived at the end of February. In the meantime, we are having to deal with fairly high inflation. Does that mean that significantly less can now be achieved with the funds available? Can you quantify that yet?

Lambrecht: It's not possible to quantify that seriously. What we can see is that demand on the arms market is increasing quite considerably. That's why we've put a lot of energy into our negotiations on the F-35 fighter aircraft, the CH-47F helicopter and other projects. We will now do everything we can to ensure that taxpayers' money is used well and efficiently. I will only be satisfied when suitable equipment reaches the troops quickly. To this end, we will also hold industry to account.

ESD: Time and again there is political discussion about whether Germany needs a National Security Council. Haven't the crises of the past years - Corona, the flood, Ukraine - proven that such a steering mechanism would be useful? And can't the



Photo: Lockheed Martin

The F-35 multi-role combat aircraft from Lockheed Martin will ensure nuclear sharing

Corona Crisis Staff, which Major General Breuer headed, be a model for this?

Lambrecht: The examples you mentioned have shown, first of all, that we need to better position ourselves to manage and control crisis situations. That's why we'll soon have the Territorial Command. This is where crucial threads will come together.

ESD: In the coalition agreement, a "stock-taking" was announced with the aim of

increasing operational readiness. When do you expect this to happen? Are there already initial results?

Lambrecht: We initially analysed the most urgent needs and very quickly implemented certain measures in advance. Experience from recent crisis situations has shown that regional structures need to be strengthened. To this end, the new Territorial Command will ensure command and control from a single source in the future.



MORE THAN JUST A TENT.

The portable shelter system consists of different modules that cover the areas of temporary accommodation, catering, sanitation and hygiene.

Discover the unique composition which is manufactured according to military specifications and modified for maximum robustness at [kaercher-futuretech.com](https://www.kaercher-futuretech.com).

FUTURETECH

Kärcher Group



The CH47 heavy transport helicopter will replace the ageing CH43 transport helicopters

In addition, the Army will be reorganising itself from October 2022. The aim is to increase readiness, with the focus on national and alliance defence. We are also looking at other measures.

ESD: The procurement list that has been drawn up in connection with the special fund is quite extensive. What is considered especially high priority?

Lambrecht: My focus is on the things that are directly needed for protection and function: first of all, the personal equipment of the soldiers. The decisions for the TORNA-DO successor and for the heavy transport helicopter were overdue so as not to lose capabilities. It is also essential that they can be implemented quickly and at low risk. That is why market-available, proven systems are preferred. This also applies to digital command and control capability and interoperability with our partners, for which we need a modern generation of radios.

ESD: So far, the German Armed Forces are planning to increase their personnel numbers to 203,000. In view of demographic data and strong competition on the labour market, this is proving difficult. Do you have to rethink this?

Lambrecht: Recruiting personnel is currently challenging, especially due to demographics and the shortage of skilled workers. Like any civilian company, we have to compete for our young talent. The phenomenon is not new, but overall the Bundeswehr is doing well on the labour market. In surveys - especially among young people - we are one of the most attractive employers. Nevertheless, we have to work even harder to recruit personnel - and take advantage of every opportunity that presents itself.

ESD: Does the new German Armed Forces Procurement Acceleration Act fully meet your expectations? Is there a need for further action? If so, where?

Lambrecht: Even before the Procurement Acceleration Act, we had already started to make things easier by raising the threshold for direct procurement. For 20% of contracts, this means that a formal and therefore often lengthy and complicated invitation to tender can be omitted. This is a significant step. The Procurement Acceleration Act is now a major step forward because it makes the procedures much easier. The Bundeswehr's procurement system has been much criticised. But we must not forget: Our personnel can only work as efficiently as the legal rules allow. And this is where there have been considerable bottlenecks in the past. Contracts were awarded in chunks and it was not easy to combine them. Lawsuits could drag on and even completely slowed down projects. With the new law, we are loosening the shackles at a crucial point. Are there any other measures? I don't want to rule it out. But the first thing now is to operate in an unhampered manner. There is a lot of work waiting in the pipeline.

ESD: For the German Armed Forces, the "turn of the times" was understood primarily in material terms. Does the Bundeswehr also need a different mindset in these times? What should this look like?

Lambrecht: A year ago, we terminated the Afghanistan mission after 20 years. Most soldiers have grown up serving in operations, and they have carried out their political mandate.

Since the annexation of Crimea in 2014, which violated international law, the focus has shifted back toward national and alliance defence. Russia's invasion of Ukraine now finally marks the "turn of the times," as the German Chancellor put it. The troops understand this very well and are keeping a close eye on the situation in Ukraine. That new mindset has been there for a long time.

Now the troops need equipment, infrastructure, personnel, and faster procedures. To achieve this, all players within the Bundeswehr must pull together and consistently focus on operational capability. We have been hearing this for years, but now there is no alternative.

But the Bundeswehr needs the support of politics, industry and society as a whole just as much. A change of mindset toward the Bundeswehr is perhaps also called for there. And I also see it as my task to campaign vigorously for this.

The interview was conducted by Rolf Clement.



As part of the naval arsenal, the MV shipyard will ensure that long shipyard layovers are avoided.

TOTAL NAVAL DOMINANCE



Leonardo has more than 60 years' experience providing the most comprehensive, integrated portfolio of naval dominance products to customers worldwide, including multifunction AESA and tracking radars, multi-sensory weapon control systems, panoramicIRST, integrated communication systems and advanced combat management systems for total information superiority at sea.

Visit us at Euronaval 2022



leonardo.com



“Finland has Longstanding Armaments Cooperation with NATO”

Photos: Finnish MoD



Finland has consistently taken a pragmatic approach to defense policy. When the Cold War ended, most Western countries reduced their defense spending and shifted to small professional armies. Finland, however, took a different approach - not least because of its 800-mile border with Russia. Helsinki insisted on conscription and a large defense budget. ESD had the opportunity to talk to Lt. Gen. Timo Kakkola, Deputy Chief of Staff, Logistics and Armaments of the Finnish Ministry of Defence.

ESD: Can you briefly elaborate on the tasks and responsibilities of the Resource Policy Department in the Finnish MoD?

Lt. Gen. Kakkola: Resource Policy Department (RPD) is one of the three departments in the Finnish MOD. It is responsible for outlining defence material policy in the Finnish defence capability building process as well as directing the personnel and employer policy, real estate and environmental policy. RPD also gives guidance to the ICT-policy within the defence administration.

RPD consists of five units having the responsibility of the above-mentioned main tasks; Materiel Unit, Strategic Projects Programme, Personnel Unit, Real Estate and Environment Unit and ICT Unit. RPDs' main task is to give MoD level guidance in these areas within the whole defence administration, and in broader terms, to secure needed resources for national defence within these specific areas, including in preparation for times of crisis.

In defence materiel procurement, RPD gives materiel policy guidance to the Finnish Defence Forces, coordinates procurements, and decides on case-by-case basis the procurement model. RPD also defines security of supply and industrial participation requirements based on national requirements. RPD runs the Defence Administration Commercial Board which gives its endorsement in all procurements with a value exceeding EUR 15

million, subject to procurement decision by the Minister of Defence.

Finnish capability building is based on long-term planning. National strategies like governmental programs, foreign and security policy reports and defence reports lay the political foundation for defence capability planning. Based on that, Defence Command Finland (DCF) develops, together with the services, a detailed-long term development program which is the base for national capability building and procurement. RPD coordinates the procurement process and Defence Forces Logistic Command is the procurement authority subordinated to the DCF.

ESD: What are the lessons learned from the war in Ukraine? Has the war lead to new procurement priorities or an adaptation of the Finnish procurement policy?

Lt. Gen. Kakkola: Finnish defence administration material policy and administrative acquisition guidance/regulation is based on mandatory legal rules and principles. EU and national procurement law promotes competition, which is fundamentally an obligation running through the legislation. The law does identify circumstances where the obligation to have a wide, transparent and non-discriminatory competition is not mandatory. These situations are covered by exceptions within the said legal regime. In general, the on-going crisis has had

very little impact to Finnish material policy or procurement procedures. Security of supply has always been a requirement of great importance to us. No doubt the war in Ukraine has highlighted this and maybe somewhat shifted the focus to a more pragmatic understanding of Security of Supply. Another observation is the sudden and urgent need for many countries to raise their stocks and supplies, which has led to delays in deliveries.

ESD: Are you investing increasingly in the protection of the Finnish/Russian border?

Lt. Gen. Kakkola: The Finnish Border Guard is a security authority functioning under the Ministry of Interior. The Frontier Guard is responsible for border safety and security, border surveillance, border checks as well as maintaining order at Finland's border areas in all circumstances. Securing the border areas is based on adjustable threat assessments that implicates selecting focused capabilities in order to facing the needs and challenges. Sustaining and further developing of technical systems and material can be seen as a routine action and everyday function in the Border Guard. Based on Finnish Legislation concerning border security, the Border Guard has solid mandate to build up a border obstacles (ex. fence) whenever decided. During wartime Finnish Border Guard can be merged to FDF (Finnish Defence Forces). All the necessary planning has been made during peacetime.

ESD: Against the background of Finland's forthcoming NATO membership, what kind of armament cooperation already exists within the framework of NATO?

Lt.Gen. Kakkola: Finland has longstanding armaments cooperation with NATO due to our long-term and stable position as a partnership country. We are already represented in many of the working groups under the CNAD, like NAAG, NAFAG and NNAG and their several sub-committees. Finland has also had a representative in the NSPA for over a decade. Full NATO membership will, of course, open some new working groups dedicated to members only. Finland's presence in the current working groups will also increase along with membership. We are looking forward to expanding our existing armaments cooperation in this regard.

ESD: What plans are in place for the equipment of Soviet origin that is still in service with the Finnish defence forces - assault rifles, artillery systems, etc.?

Lt.Gen. Kakkola: Finnish Defence Forces has some equipment of Soviet Union origin in its inventory. Such material includes for example transport equipment, artillery weapons etc. Such remaining material will be maintained until the end of its capability life-cycle. Most of such materiel has been purchased as surplus from the former East-Germany. FDF has a spares stock enabling self-sufficient maintenance of the materiel until end of life-cycle.

ESD: What is the status of the ongoing cooperative armament efforts among the Nordic countries? Does the Norwegian company Kongsberg, as one of the shareholders of Patria, have a special role?

Lt.Gen. Kakkola: Nordic countries have cooperated in the field of armaments within the NORDEFCO framework. The basis for this cooperation is laid in the defence materiel agreement between respective countries, which was signed in 2015. This agreement has later been complemented with annexes focusing on joint procurement, security of supply and export control.

With the proper legal framework in place, the Nordic countries are exploring opportunities of practical cooperation in related fields. Some joint projects have been initiated and currently there is e.g. ongoing work in the area of security of supply. Opportunities for joint procurement are also systematically scanned. Kongsberg is an important player both as a provider of some key capabilities to

Finnish Defence Forces (FDF) as well as being the other major shareholder of Patria. When taking part in the invitation to tender by the FDF it does however not have any special role because of its position but is treated as any bidder according to the principles described in the relevant defence procurement legislation, namely – equal, non-discriminative and transparent treatment of all economical operators.



Bucking the international trend after the end of the Cold War, Finland has maintained conscription.

ESD: Initiated by the Obama administration as European Phased Adaptive Approach, NATO is developing a European BMD capability. Does Finland plan to join this effort? Or do you have different plans?

Lt.Gen. Kakkola: In general, Finland as a future NATO member supports initiatives that contribute to the Alliance's common defence and deterrence. Regarding the potential Finnish role in this capability, we will engage in consultations at the national level and with all partners as appropriate.

ESD: Compared to other European nations Finland's defensive capabilities are based on a huge number of civilian reservists. What effect does that have on procurement objectives? Can you elaborate on the procedures for the "procurement" of infrastructure, namely bunkers?

Lt.Gen. Kakkola: Not surprisingly, a major challenge concerning acquisitions and having a large reserve is the volume itself and all that that comes with it, storage, lifecycle management etc. The notable number of reservists can bring surprises in seemingly ordinary acquisitions. There are a great number of countries with less wartime strength and products that work well for others might require modifications to our need,

which is always costly. In general though the overall concept we have has been in place for decades and thus poses no extra challenges. Bunkers mainly follow the same policies and guidelines as other acquisitions.

ESD: What plans are in place with regard to Finland's future role as a NATO Host Nation?

Lt.Gen. Kakkola: Finland has signed HNS MOU with NATO 2014 and HNS TA May 2022. Finland has acted as a Host Nation for troops in exercises since 1990, and hence, the issue is not unfamiliar to us. However, of course, Finland's future role as a NATO Host Nation will be specified within operational and defence planning processes with NATO.

ESD's interview questions were asked by Jürgen Hensel.

Amid Western Concerns, India Sends Army Contingent to Russian Vostok 2022 Exercise

Suman Sharma

Coming close on the heels of India's first vote against Russia at the United Nations (UN), the Indian Army participated in the Vostok-2022 multilateral, strategic and command exercise organised by Russia at its Sergeevsky Training Ground of the Eastern Military District, held from 1-7 September. The move invited mixed reactions from global powers. Aimed at demonstrating interoperability and coordination amongst participating military contingents and observers, Vostok-2022 was the first of Russia's large-scale military drills to be held since the War in Ukraine began in February this year.

The Indian Army contingent was relatively modest, comprising 75 troops from the 7th Battalion, 8th Gorkha Rifles regiment. During the drills, India's troops participated in joint field training exercises, combat discussions, and firepower demonstrations. The scope of the Indian Army delegation's participation was to share practical experience and put into practice various drills, procedures, and practice amalgamation of new technology, through discussions and tactical exercises.

India's participation has raised temperatures for a variety of reasons, first among them being the ire it drew from friendly nations like Japan and the US. The other reason being the presence of China at Vostok-2022, causing India's own participation to be seen as a misjudgement.

The timing of this exercise assumes significance as it came immediately after the United Nations Security Council (UNSC)'s "procedural vote" held on August 24, in which India voted against Russia in favour of Ukraine for the first time since the War in Ukraine started. India is a non-permanent member of the 15-member UNSC, for a two-year period which ends in December 2022. So far,

Photos: Russian MoD



The inauguration ceremony of exercise Vostok 2022 took place at Sergeevsky training ground in Primorie region



Indian, Chinese, Algerian, and Russian soldiers joining hands during exercise Vostok 2022

Author

Suman Sharma is a Delhi-based journalist covering foreign policy and defence. Previously, she was an instructor at the Indian Military Academy.

India has abstained at all UN votes on the Ukraine-Russia issue, drawing annoyance from Western Powers, as New Delhi's abstinence was seen to favour Moscow.

However, India did refuse participation in the maritime component of Vostok-2022, following Japan's protest, confining its participation to the strategic staff and command manoeuvres. The naval drills were held in the Sea of Japan and the Sea of Okhotsk, with warships from the Russian Pacific Fleet and the Chinese People's Liberation Army Navy (PLAN) in attendance.

Former Indian Naval Chief Admiral (ret'd) Karambir Singh stated, "India's strategic autonomy unlike in the past is characterised by more engagements, issue-based convergences and not being dragged into a Cold War mentality. Therefore, we are doing what we have done before and not altering the status quo. The Navy never participated in Vostok and therefore is not participating this time. All our actions are based on what suits our interests and not due to pressure from others."

Japanese and US Reactions

Tokyo registered its protest to Moscow for conducting the maritime drills of Vostok-2022 near the Northern Territory of Japan, which is home to the Southern Kuril Islands, claimed by both Russia and Japan, making it a disputed territory.

A Japanese officer (not wishing to be named), said, "It is totally unacceptable for Japan that any military exercises would be conducted by Russia in this region. In this regard, the Japanese Government has conveyed its standpoint to the Indian Government through various occasions and been notified by the latter that the Indian side would not participate in any military drills being conducted in the Northern Territory."

It should be noted that India and Japan are partners in the Quadrilateral Security Dialogue, popularly known as 'Quad', with Australia and the US being the other two members in this four-member grouping. The Quad is often seen as intended to counter China's aggressive posture in the Indo-Pacific region. Recently India and Japan conducted their annual 2+2 ministerial, in which the In-

dian Defence and External Affairs ministers met their Japanese counterparts in Tokyo, a meeting that came a day after the conclusion of Vostok-2022. The two Defence Ministers agreed to enhanced cooperation on the need for greater interoperability between their two air forces. This culminated in an agreement being reached for the first joint air force exercise between India and Japan, the details of which will soon be worked out. Perceiving an increasing threat in its neighbourhood, Japan has been buttressing its military capabilities. The Jap-

anese Premiere has also committed to a considerable boost in defence spending, with an assurance of doubling Japan's military budget to two percent of GDP in the next five years, amid concerns over the Russian invasion of Ukraine emboldening China to attempt a similar action in Taiwan. It has also been reported that China and Russia could engage in a second joint naval patrol after the conclusion of Vostok-2022. This is especially significant since it could signal an even closer bond between Moscow and Beijing in the maritime realm.



THE XIIITH EDITION

OF THE SPECIAL OPERATIONS FORCES EXHIBITION & CONFERENCE

SOFEX JORDAN

2022



31ST OCTOBER- 03RD NOVEMBER



THE AQABA GATE AVIATION
KING HUSSEIN INTERNATIONAL AIRPORT



Indian detachments were among other international ones at the inauguration ceremony of Vostok 2022

Meanwhile, the US State Department spokesperson Ned Price said at a press interaction, "Reorienting a country's foreign policy or a country's security establishment or defence procurement practices away from a country like Russia is not something that we can do overnight. It's not something that we can do over the course of weeks or even months. We do see this as a long-term challenge," adding that for countries like India which have had long, historical ties with Russia, it would be a long-term proposition to reorient its foreign policy.

As Western powers have been seen trying to wean away India from the Russian camp, especially after the war began, New Delhi has shown its strategic autonomy in various matters, from buying arms and oil

from Russia, to participating in Russian military drills. Commenting on the issue White House Press Secretary Karine Jean-Pierre said, "The United States has concerns about any country exercising with Russia."

Vostok-2022

Participating contingents and observers in Vostok 2022 included Algeria, Armenia, Azerbaijan, Belarus, China, India, Kazakhstan, Kyrgyzstan, Laos, Mongolia, Nicaragua, Syria, and Tajikistan.

According to the Russian Ministry of Defence, the war games were scheduled to take place in 13 training grounds in Russia's Eastern Military District, including manoeuvres involving units of long-range bombers, airborne troops, and military cargo aircraft.



A Joint Staff of international forces involved in Vostok 2022 starts its work at Sergeyevsky training ground

India has regularly participated in multinational military drills in Russia, including the 'Zapad-2021' exercise, and many of these exercises have included a Chinese contingent. Regarding India's participation, Indian Ministry of External Affairs (MEA) spokesperson, Arindam Bagchi stated "Let me just emphasise that India has been regularly participating in multilateral exercises in Russia, along with a number of other countries. I understand there will be only army participation in the Vostok exercises this year."

India-Russia Ties

Russia and India have been historic partners since the time of the Soviet Union, and even today India has a sixty percent dependence on Russia for arms imports. Recently, Saudi Arabia was replaced by Russia as India's second-largest oil supplier. Defence, trade and energy are the key drivers of this longstanding relationship. Going by official figures, Russia-India bilateral trade for the year 2020 was around USD 8 billion, which is lower than India's trade with other large states such as China and the US. During President Putin's India visit in December 2021, India and Russia's joint statement mentioned that, "the leaders stressed the need for greater efforts to achieve the trade target of USD 30 billion by 2025. In this regard, they placed strong emphasis on new drivers of growth for long-term cooperation."

Russia and India already hold a regular defence exercise, named 'Indra', which was just a naval exercise when it began in 2003, but has since evolved into a biennial, tri-service drill. Vostok-2022 on the other hand, had more symbolic value for President Putin, insofar as it served to demonstrate that he could successfully put together a large military drill amidst an ongoing war.

New Delhi and Moscow's relationship looks to continue along despite the recent UNSC vote. Both are members of BRICS and the Shanghai Cooperation Organisation (SCO). The two already collaborate on annual military technical cooperation meetings, and their interdependence has increased in recent months owing to India's energy security needs. Notwithstanding Western pressures, New Delhi has been going ahead with its purchases of cheap Russian oil, seen as a win-win by both nations, as most of Moscow's energy market has dwindled due to Western sanctions. Aside from this, Russia holds influence in Central Asian states, which are as important to meeting India's energy requirements as Russia itself. The way forward, therefore, would seem to favour cautious pragmatism. ■

The EU's Vanishing Dream of Energy Security

How a Desperate Shift Away from Russian Energy Dependence Ushers in a Greater Challenge for the European Union

Brendan P. Dziama & Juan Manuel Chomón Pérez

Since 1952, the European Union, represented at that time by the European Coal and Steel Community, has succeeded tremendously in its core pursuit of collective peace and prosperity through enhancing economic cooperation within a single market. While this international approach has afforded the bloc the ability to compete with superpowers, it has not offered enough protection against some of the negative consequences of globalisation in a modern era defined by outsourcing and cost-based decision-making.

As is clearly highlighted by the current War in Ukraine, the EU's dependence on Russian energy has demonstrated the ever-narrowing gap between economic and security policy, as well as the far-reaching effects associated with the weaponisation of critical resources and supply chains. Yet as difficult a position as the EU finds itself in with Russia, there exists an even more dangerous economic relationship with far deeper, long-lasting implications and even fewer opportunities to decouple.

Commission announced the REPowerEU initiative designed to “rapidly reduce dependence on Russian fossil fuels and fast forward the green transition.” In addition to finding short-term alternative sources of oil, gas, and coal, a key element of this plan includes the dramatic expansion of clean energy technology, with an increase in the EU's clean energy target from 40% to 45% by 2030. What the press release and factsheets fail to mention, however, is that this plan for reduced dependency on Russia demands an increased dependency on China.



Photo: ERMA

The European Raw Materials Alliance aims to contribute to Europe's industrial resilience by capacity-building at all stages of the raw materials value chain, from mining to waste recovery.

Authors

Lieutenant Colonel (LtCol) Juan Manuel Chomón Pérez is a pilot of the Spanish Air Force with 12 years of extensive international experience in France, Netherlands, Germany, Italy, Djibouti, Mauritania and Afghanistan.

Lieutenant Commander (LCDR) Brendan P. Dziama has seven years of operational experience as a Surface Warfare Officer in the US Navy specializing in operations in Southeast Asia and the Middle East. In the previous five years his focus has shifted to international security cooperation and development, splitting time between Europe and Sub-Saharan Africa.

Rare Earth Metals, or simply 'rare earths' have become indispensable components in manufacturing the technology that powers daily life. Computers, mobile phones, satellites, robotics, electric vehicles and modern medical equipment are among the myriad of products that rely on the successful exploitation of this non-renewable resource and, over the past 30 years, China has strategically cornered the market. Low labour costs, high government control over industry, and lax environmental regulations have contributed to China's ability to offer an economical solution to rare earth mining, manufacturing, and processing while the rest of the global free market all too willingly ceded control.

In response to Russian aggression in Ukraine, on 18 May 2022 the European

Commission announced the REPowerEU initiative designed to “rapidly reduce dependence on Russian fossil fuels and fast forward the green transition.” In addition to finding short-term alternative sources of oil, gas, and coal, a key element of this plan includes the dramatic expansion of clean energy technology, with an increase in the EU's clean energy target from 40% to 45% by 2030. What the press release and factsheets fail to mention, however, is that this plan for reduced dependency on Russia demands an increased dependency on China.

Like most modern technology, manufacturing clean energy infrastructure relies on rare earths. When considering the entire supply chain, it is estimated that China is responsible for 98% of the rare earth materials required for the wind turbines, electrical vehicles, and high-power batteries that the EU's Green Deal is entirely dependent on. By comparison, the Organization of Petroleum Exporting Countries (OPEC), the world's largest energy monopoly, currently controls 40% of global oil production, and with that stake, has yielded tremendous geopolitical power for its members for decades.

It can be argued that part of OPEC's comparative advantage is that its member states sit on nearly 80% of proven oil reserves whereas only 37% of known rare earth deposits are located in China. How-



Photo: European Space Agency, via Wikimedia Commons

A toxic lake has formed at Baotou, China's largest rare earth mine. The sludge contains chemical waste products from mining and processing rare earth minerals.

ever, China's real strength lies beyond the mines. Refining the material and manufacturing the end products involves costly and environmentally-challenging processes that most of the world has all but abandoned in pursuit of short-term financial gain and popular pressure to combat climate change and pollution.

The EU's response to Russia's invasion of Ukraine has been, in most respects, unprecedentedly resolute – highlighted by a comprehensive flight ban, coordinated economic sanctions, Sweden and Finland's bid for NATO membership and, most recently, Denmark's joining of the Common Security and Defence Policy (CSDP). Yet it's difficult to envision a similar response against a potential adversary whose isolation from the global community would have far wider-reaching, and more devastating consequences. In the past few years, there have been instances where the EU has demonstrated concern for the actions of China – con-

demning human rights abuses against the Uyghur population, promoting alternatives to the 'Belt and Road Initiative' for Africans, and criticising the recent violations of electoral processes in Hong Kong. Yet apart from some symbolic and soft exchanges of sanctions, Europe has been careful to pull up short of anything that can be seen as strongly antagonistic to their largest trading partner.

As China observes the global response to Ukraine, it is undoubtedly considering options and timing with regard to its own long-proclaimed pledge to reunite Taiwan with the rest of the country. However, the assertive declarations of President Biden in May and Speaker of the House, Nancy Pelosi's controversial diplomatic visit to Taiwan in August, have demonstrated renewed US resolve to counter such aims. The EU, on the other hand, has shied away from adopting such a strong stance. When Lithuania opened a 'Taiwan Representative Office' in 2021, the response from China was swift – unofficially restricting trade relations with the small Baltic nation and applying indirect economic pressure via the rest of the EU. Despite some condemnation of Beijing's discriminatory measures and offers of economic support to Lithuania, the overall response from the rest of the European bloc was mostly non-committal, following an increasingly common pattern of strategic ambiguity.

Much like Vladimir Putin's periodic tests of EU resolve, dating back to his bombastic statements at the Munich conference of 2007, it can be argued that China's attempts at economic coercion are similar, comparatively small-scale probes, presaging future, larger-scale action. Despite the EU's sanctions and censure that followed the war with Georgia,

the illegal annexation of Crimea, and several instances of political interference, Russia's lucrative energy arrangement with the bloc continued to grow, further deterring the use of the available weapons in Europe's future foreign policy arsenal. Unfortunately, the responses to Beijing's recent antagonisms fail to demonstrate that those lessons have been learned. The condemnation of a beligerent is only as strong as a deepening, economic reliance will allow it to be.

While it can be argued that China's equal dependence on the West as trade partners would limit its option to play the 'rare earths card' – a rare earth export ban – that situation may not be permanent. China has now twice threatened US arms manufacturers with rare earth boycotts in response to sales of military equipment to Taiwan, but both times has failed to follow through. However, as Beijing employs its own form of strategic ambiguity in the Russian-Ukraine War, it is positioning itself well for a pivot to counter any potential future economic interruption. With January's implementation of the Regional Comprehensive Economic Partnership (RCEP), the world's largest trade agreement, and Beijing's "Made in China 2025" initiative, it may be only a matter of time before Xi Jinping feels comfortable taking more concrete steps to fulfil his foreign policy aspirations.

Yet even if the EU were to apply lessons learned from Russia, when considering the rare earth market, there is no realistic alternative to China's supply chain. Unlike with Russian oil and gas, no other partner exists to whom the EU or the US could turn to in the face of trade interruption. It is a difficult and environmentally challenging infrastructure that China has perfected and patented for decades while the rest of the world idly sat by.

Perhaps even more alarming than the EU Green Deal limitations are the direct military implications. In one of the first big decisions since its USD 100 billion defence pledge, Germany recently decided to purchase 35 F-35A fighter aircraft from the United States. It is an impressive piece of equipment which can provide both strategic and tactical capabilities but, as can be expected with most modern military technology, it relies heavily on rare earth components imported from China. As fears mount regarding China and Russia being drawn closer together, any current comparative advantage for the western alliances in a theoretical military conflict, in Europe or Southeast Asia, must be weighed against long-term forecasts regarding the sourcing of such critical materials.

The Paris Agreement of 2015 reinforced the EU's status as the global leader in the crusade against climate change and Russia's latest ag-

Photo: RAF



The F-35 fighter aircraft relies heavily on rare earth components imported from China.

SUPERIOR PERFORMANCE. MAXIMUM FLEXIBILITY.



LIONFISH® Family

21st Century naval operations demand reliable defensive systems.

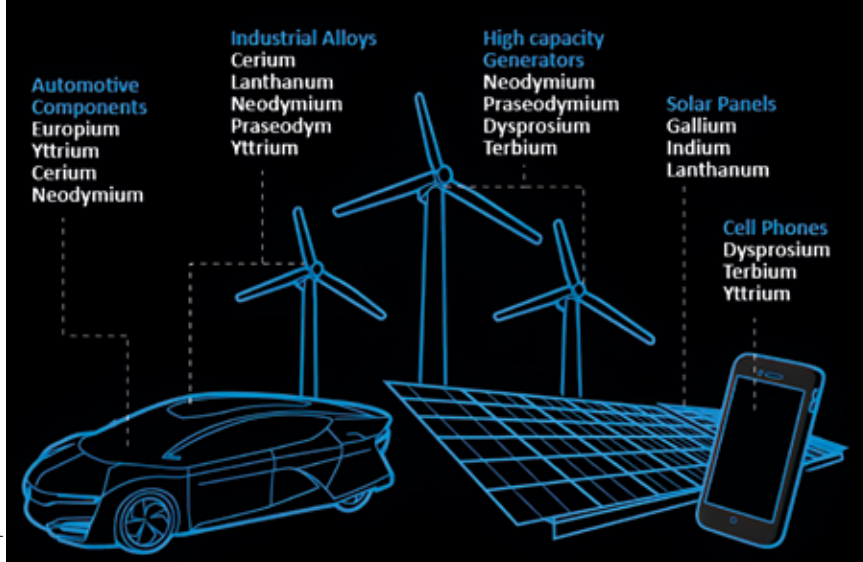
Leonardo presents LIONFISH® – the latest-generation family of remote-controlled small calibre naval gun systems; enabling high-performance and precision with lightweight, compact flexibility by design. LIONFISH® provides uncompromised defensive capabilities for surface vessels, ensuring mission success.

Visit us at Euronaval 2022



leonardo.com





There is no green energy without rare earths.

gression compelled many member states to increase investments in defence technology. However, what fails to be properly accounted for is that both of these pursuits are heavily contingent on an uninterrupted flow of rare earths. This entails being on the receiving end of a supply chain monopolised by a nation that does not share the same democratic principles, is less constrained by environmental standards, and, against whom, the EU will be increasingly challenged to act.

There are efforts to correct this imbalance. From 2013-2017 the European Commission funded EURARE—a project for the “development of a sustainable exploitation scheme for Europe’s rare earth ore deposits” — that ultimately surveyed and investigated 76 different locations for mining within the bloc. But despite the initial optimism, the project’s recommendations have largely been shelved as popular environmental concern blocks any attempt to secure mining licenses. To this day, there are no active rare earth mines in Europe. More recently in 2021, the European Raw Materials Alliance (ERMA) (another Commission brainchild) published a ‘Call for European Action’ with a proposed industry-led investment pipeline through which 20% of EU rare earth demands could be sourced locally by 2030. Unfortunately, ERMA now faces a similar fate as EURARE, with risk-averse private investors cautiously considering shifting political regulations, the unpredictability of global markets, and the high costs of developing a complex supply chain.

The United States has also been attempting to address this strategic challenge. Since 2020, Congress has twice introduced legislation designed to both restrict the use of Chinese imported minerals in military technology and support the development of local industrial infrastructure. The Department of Defense (DoD) is funding the development of a processing facility for the MP Materials Corporation in Mountain Pass, California, the only active US rare earth mine, and has awarded millions to Australian-based Lynas Rare Earth for similar developments in Texas. Furthermore, in the private sector, Energy

Fuels has teamed up with Canadian-based Neo Materials, owner of the only relevant rare earth processing plant in Europe, to propose a North American-European rare earth supply chain that creatively leverages multinational strengths and promotes environmentally responsible, sustainable exploitation.

However, critics are quick to point out how similar efforts in the past have failed. From 2010-2015 the private investment firm, Moly-corp, sank USD 1.5 billion into revitalizing Mountain Pass under ‘Project Phoenix’ before ultimately collapsing into bankruptcy under intense market competition and pressure from environmental groups. Despite the initial political enthusiasm, both rare earth bills still sit in Congressional committees, awaiting further action, behind higher-priority legislation.

One such bill is the Inflation Reduction Act, which passed narrowly in the House and the Senate and was signed into law by President Biden on 16 August 2022. Among its provisions are incentives for the green energy sector and an expansion of the presidential budget for the Defense Production Act of 1950. While this could provide the catalyst necessary to support rare earth supply chain development, critics of the bill argue that it does not go far enough to demand energy independence. While many within the EU applaud the renewed US commitment to clean energy principles, there is concern that this semi-isolationist policy will unfairly prejudice European industry in potential violation of World Trade Organisation (WTO) rules.

The current economic fallout from the War in Ukraine incentivises the EU to urgently pursue independent supply chains. However, absent staunch, sustained government support, it is unlikely that private industry will be able to weather the challenges and develop a viable competitor to the Chinese rare earth monopoly. Considering the current situation, the EU has two options: (1) Aggressively promote and support the development of mines and processing facilities within the bloc; and/or (2) Partner with like-minded allies outside of Europe and in order to more equitably share the burdens and evolve the technolo-

gies necessary to responsibly develop this essential infrastructure. One such potential external partner could include Turkey who, in July 2022, announced the discovery of the world’s second-largest reserve of rare earths. Despite an often strained relationship with the west, Turkey remains a NATO member and these critical deposits could prove an important strategic edge to the alliance.

Through EURARE and ERMA the EU Commission has supported these pursuits, but the complex nature of the legislative process makes the elevation of opinions and recommendations to directives and regulations extremely difficult. With its somewhat unstable, semi-federal political status, it is challenging for the EU to gain the required consensus to form strategic partnerships outside the bloc and pass regulations that won’t erode member-state sovereignty. However, as recently illustrated by both the global pandemic and Russia’s aggression in Ukraine, the EU is improving its capacity to react more quickly and decisively in the face of a crisis.

However, compared to oil and gas, the threat of Chinese rare earth monopoly is either widely underestimated or conveniently ignored across most of Europe. The best estimates for creating independent rare earth supply chains outside of China predict a minimum of 10-15 years for development, not including for the considerable risks of such ventures. By not prioritising rare earth supply chain development, the EU’s rapid charge towards clean energy solutions will trade a nearly 30% dependence on Russian oil and gas for a substantially higher, and significantly more dangerous reliance on China. As a result of the increasing interconnectedness between economic and security policy, EU inaction here risks jeopardising not only its goals for energy independence but also its support to democratic values abroad and its ability to maintain strategic autonomy amongst global superpowers.

When French Foreign Minister Robert Schuman initially proposed the European Coal and Steel Community in 1950, its purpose was to pool resources and remove competition over critical materials that had twice since fuelled catastrophic world wars. In Schuman’s own words, this unity of effort would make war between rivals “not merely unthinkable, but materially impossible.” It required some short-term national sacrifices but, as one of the foundational actions of the EU, this action can be considered at least partially responsible for the bloc’s historic period of subsequent stability. Considering modern challenges to European solidarity — both internal and external — it is time for the EU to consider a similar, unifying effort with the same aim and potential for fostering long-term peace and sustainability. ■

Delivering superior navigation.



Marins Series

Combat-proven FOG
Inertial Navigation
Systems Limited drift
up to 1Nm/360h

iXblue

Lightweight Mobile Field Artillery

A game changer for land operations?

Jean-Francois Auran

Mobile artillery is characterised by substantial firepower, always associated with significant mobility.

This article focusses on mobile artillery, including 81 mm and 120 mm mortars, 105 mm light howitzers, and heavier 155 mm howitzers.

During the First World War, the opposing armies engaged in self-propelled artillery trials. In 1924, the technical section of the French Army designed a prototype combining a 75 mm gun on the FT17 tank. Various pieces of equipment were later developed and produced during the Second World War. The Germans became the specialists, using, in many cases, tanks taken from the enemy.

Historical Background

On the Allied side, we can cite the SEX-TON self-propelled gun, which consisted of a 25 pound gun mounted on a Canadian RAM tank chassis. In 1942, Sub-Lieutenant Adrien Conus installed the French 75 mm model 1897 on the chassis of a Ford or Chevrolet truck. These guns distinguished themselves during the Bir Hakeim battle. Since then, it has seen numerous improvements in its ammunition, fire control devices and carriers. With French help, Israel has developed very innovative solutions since the 1950s. These include self-propelled artillery and mortar systems.

With the end of the Cold War, the development of peacekeeping and later, counterinsurgency operations, combatant units relied on fixed guns and mortars on bases or developed an over-reliance on air support. This type of artillery is gaining interest in the context of Large-Scale Ground Combat Operations (LSGCO) linked with new target acquisition capabilities and the need for highly mobile forces.

Onboard Mortars

The modern mortar appeared in the trenches in 1915, thanks to Edgar Brandt. It

quickly became a best-seller, with the Soviets later adopting the 82 mm instead of the French 81. This article will focus on 81 mm mortar, as well as on 120 mm calibre, which constitute real artillery for the infantry battalion commander and have established themselves as an international standard.

The 81 mm mortar continues to undergo development because it is lightweight and has an increased range. The Spanish company EXPAL offers its Dual-Eimos system, which consists of two 81 mm mortars on a 4x4 VAMTAC ST5 platform. Thales has installed an 81 mm mortar on a 4x4 Toyota Land Cruiser, baptising this weapon system the Max3 4x4. This very compact mortar can also support highly mobile units such as Special Forces.

Specialists highlight the difference between smoothbore and rifled mortars, muzzle, or breech loading. Today, 120 mm mortars represent the preferred support solution, even if 107 mm mortars are still in service worldwide. They can now be installed on 4x4 vehicles in containers, and even on small ships. The most famous is the towed rifled mortar of 120 Rayé Tracé (R.T.) produced by TDA of the THALES Group, in service in 25 countries. In 2007,

Photo: Jean François Auran



The Elbit SPEAR, is a highly automated, vehicle-mounted 120 mm soft recoil mortar system. The mortar is a derivative of the CAR-DOM battle proven mortar system

Photo: Arquus



The SHERPA A2M (advanced Mobile Mortar) combines a 120 mm rifled mortar barrel with the mobile mortar system from NTGS into a mobile and protected platform from Arquus.

Author

Jean François Auran is a retired French Armed Forces officer and a Defence and Security Analyst.

the company developed an onboard version named Rifled, Recoiled, Mounted Mortar (2R2M), combining automatic aiming and semi-automatic loading, available for armoured vehicles weighing more than 10 tonnes. Thanks to its recoil brake, the onboard mortar is twice as accurate as the conventional 120 RT. This system will be integrated into the French Army's GRIFFON combat vehicle under the acronym Mortier Embarqué Pour l'Appui au Contact (MEPAC). At least 54 GRIFFON MEPAC vehicles will be delivered between 2024 and 2027. The development of the laser-guided 120 mm mortar munition (range 17 km and sub-metric precision) by Thales is advanced and will make the MEPAC highly effective in operations. French company Arqus now offers the AZM SHERPA, which combines a 120 mm mortar with the NTGS firing platform. The mortar deployment is speedy, with automatic aiming and ballistic calculation.

Heavy Mortars

The US Armed Forces have a long history of using heavy mortars. Mortars are mostly installed on armoured vehicles such as the M1129, a STRYKER fitted with the



Photo: Thales

Loading system of the Rifled recoiled Mounted Mortar system - 2R2M. this system will equip the GRIFFON MEPAC

Israeli M120 mortar. US Marines fielded the RT120 mm towed mortar from 2008 to 2017 as the Expeditionary Fire Support System (EFSS). The US military seems interested in Patria's NEMO (New Mortar) system. A research and development agreement was signed to study the feasibility of integrating this system on US Army mortar vehicles that could equip the STRYKER brigades with a system capable of providing direct and indirect, mobile, and protected direct and indirect fires.

The Nordic countries use the CV90 MJÖLNER armoured vehicle, which has a turret equipped with two smoothbore 120 mm mortars which can reach a rate of fire of 16 shots per minute and a range up to 9 km. In 2016, Sweden signed contract for 40 artillery systems in 2016 with deliveries in 2019 and 2020. Finnish manufacturer Patria offers its NEMO, a remote-controlled 120 mm mortar system capable of firing both direct and indirect fire on the move. Patria's NEMO container version offers the

For Long Distance Surveillance



Advanced Developers Laboratory

New Model: HZ80X1235DPFIR-T

This new lens is one of the best for ...

- High Zoom Ratio
80X Zoom
- High Resolution
5.0 Mega Pixel



Specifics:

1/1.8" Image Format
Back Focus Adjustment

DC Auto-Iris
Boresight Adjustment

Fog Free Function
Temperature Focusing Control

ADL the First Name in Long Distance Surveillance, Accuracy & Clarity

Specify it by name: **HZ80X1235DPFIR-T**

www.adlinc.co.jp



Georgian DIDGOR MEOMARI equipped with a 120 mm mortar platform. The system can fire a range of mortar shells, including NATO and Soviet type.

advantage of modern turreted mortar systems, combined with an almost unlimited variety of platforms. It has space for a crew of three and 100 mortar rounds.

Poland produces the RAK 120 mm, mounted on the 8x8 ROSOMAK vehicle. It is a 120 mm breech-loading mortar with a range of 10 km and a rate of fire of 6-8 rounds. Georgia has developed a 120 mm mobile mortar system, the DIDGOR MEOMARI 120 mm. The system can fire a range of mortar shells, including NATO and Soviet standard 120 mm mortar ammunition.

Israel has extensive experience in the field of onboard mortars with the K6A3 type mortar being the most recent version. It is in service with the US Army as the M120 and M121. We can also mention the CARDOM recoil mortar system 6 light (RMS-6L) acquired in Denmark. Elbit Systems offers an updated version of its 120 mm SPEAR mortar developed based on CARDOM or HATCHET in service with several armies. The mortar can be mounted on the JLTV produced by OSHKOSH Defense. It required installing an anti-recoil system, reducing the effort from 30 to 15 tonnes, thereby allowing the weapon to be mounted on a wide variety of light or heavier tacti-

cal vehicles. The SPEAR has an autonomous navigation and aiming system, allowing it to be implemented without external means and integrated into the various systems, C4I or BMS (Battle Management System). Elbit Systems also produces the SLING, which can deliver massive firepower at a rate of 16 shells per minute, with a sustained speed of 3-4 per minute and a firing range of up to 7 km (with standard ammunition – M933 or equivalent). The mortar system is suitable for all types of qualified 120 mm smooth-bore ammunition.

Newer players have entered the market and we can cite a 120 mm mortar fitted on the Emirati HAFEET 640A armoured vehicle. Although the exact characteristics of this weapon are still unknown, it could be equipped with a recoil reduction system like the Israeli SPEAR. A Chinese media outlet broadcast pictures of this equipment on a Chinese 6x6 vehicle manufactured by Mengshi. Singapore's S.T. Engineering Land Systems has completed developing and evaluating the latest version of its 120 mm Super Rapid Advanced Mortar System (SRAMS), the Mk II, and new ammunition. The 120 mm SRAMS is the first mortar in the world with a recoil force of fewer than

30 tonnes when firing maximum charge to achieve a range of 10 km. Weighing only 1,200 kg, it can be integrated onto and fired from onboard a wide range of light tracked or wheeled vehicles, bringing incredible firepower to the lowest echelon. In 2019, Taiwan unveiled an updated version of the 81/120 mm Mobile Mortar System (MMS). Ukraine has developed an automated mobile mortar produced by Ukroboronservice, a subsidiary of UkrOboronProm. The system can be ready from travel to fire in 35 seconds.

The Soviet Union developed mobile mortars in different calibres. We can cite the case of the 82 mm 2B9 VASILEK mounted on the MTLB armoured vehicle. The 2B9M VASILEK is currently used in Ukraine on a GAZ-66 truck. There is also the 2S23 NO-NA which is fitted on an armoured BMD used by airborne troops.

105 mm Light Howitzers

The centrepiece in the field of light artillery remains the 105 mm gun. This calibre has all the qualities of range, lethality, and compact size of ammunition. There are three main towed guns of recent design. We can mention Nexter's LG1 Mark III, eight of which were sold recently in Senegal. The weapon is in service in six countries. Handy and light, it is transportable by all-terrain vehicles, including 4x4s. It can be brought into battery position in less than 30 seconds by a crew of five gunners, firing 12 rounds per minute. Nexter Arrowtech's E.R. G3 extended range ammunition is NATO certified and capable of hitting a target 17 km away. The howitzer is usually equipped with the BACARA ballistic computer and the Advans Lyra inertial navigation system from IxBlue.

The L119 Light Gun is a lightweight gun/howitzer capable of providing direct fire support against armoured vehicles or at buildings or indirect fire in support of the combat arms at ranges more than 10 km. Produced as the M119 in the United States, the M119A3 is the last version currently in service. Turkey has developed the 105 mm BORAN howitzer derived from the L119. It is air transportable by Sikorsky S-70 helicopter, weighing 1,710 kg.

The most emblematic project is the Humvee 2-CT HAWKEYE 105 mm Mobile Howitzer System (MHS), designed in cooperation between the MANDUS GROUP and AM General. It is the lightest weight, most highly manoeuvrable self-propelled howitzer in the world today. It is built around the 105 mm M20 gun, a digital fire-control system and front and rear hydraulic anchors stabilising the gun when firing. The HAWKEYE can fire and move in about 30



HAWKEYE 105 mm Mobile Weapon System is still experimental. The howitzer is very comparable to the M119 but with a soft recoil system. The system is accurate in direct fire up to 5,000 m.

ELECTRONICS & DEFENSE

OBSERVE, DECIDE, GUIDE
INTELLIGENCE ONBOARD



**SAFRAN ELECTRONICS & DEFENSE,
INTELLIGENCE ONBOARD**

Day after day, you face critical challenges. The products and services developed by Safran Electronics & Defense, whether civil or military, deliver the technological superiority, effectiveness, reliability and competitiveness you expect. We're with you every step of the way, building in the intelligence that gives you a critical advantage in observation, decision-making and guidance. You can count on Safran Electronics & Defense, your strategic partner on land, at sea, in the air and in space.

safran-electronics-defense.com

🐦 : @SafranElecDef





The self-propelled howitzer 122 mm is a Serbian howitzer developed by the Military Technical Institute (MTI) for the Serbian Army



The BRUTUS 155 mm self-propelled gun took part in Northern Strike 19. Developed by a collaborative team from AM General and the Mandus Group, BRUTUS mounts the same cannon as the M777 to a hydro-pneumatic, soft recoil system for mounting on FMTV (Family of Medium Tactical Vehicles Truck).

seconds and has a rapid rate of fire up to 10-12 rounds per minute. This artillery system incorporates a soft recoil technology, which reduces carriage loads and allows to mount of the HAWKEYE on light 4x4 vehicles such as the HMMWV. The system consists of two trucks and no trailers and can be loaded inside a CH-47 CHINOOK helicopter. The HAWKEYE can receive different barrel lengths depending on customer range requirements.

The British Army will soon see its COYOTE six-wheeled tactical vehicles equipped with 105 mm howitzer weapon systems. The COYOTE tactical support vehicle (TSV light) is based on the HMT 600 6x6 chassis from Supacat. Although the armoured vehicle already has a powerful weapon, the British Army's experience in Iraq, Afghanistan, and Syria highlighted the need for the COYOTE to have additional firepower.

India is also working on the development of a cannon fitted on a truck. About ten years ago, it was the GARUDA-105, which consisted of mounting a 105 mm LFG gun on

a TATA 4x4 truck. Today the GARUDA-105 V2 is mounted on a simple 4x4 with a 360-degree firing capability, with less than 5.5 tonnes of weight. The company has reduced the gun's weight to 900 kg by using high-strength aluminium and a hybrid recoil system, which reduced the recoil forces. The system underwent trials in high-altitude areas, a critical requirement for the Indian Army.

China has made little use of the 105 mm calibre but has nevertheless developed the SH5, an evolution of the SH2 that will be mentioned later. This is the mounting of a 105 mm gun on a 6x6 chassis. A fully-loaded SH5 weighs 11 tonnes, carries 40 rounds, and can fire up to eight rounds per minute with a maximum range of 18 km.

122 mm Howitzers

The Soviet 122 mm howitzer has been mounted on vehicles multiple times and continues to be so. The Soviets mounted it on the MTLB chassis in the seventies, giv-

ing birth to the 2S1 GVOZDIKA. The trend today is to mount these artillery pieces on even lighter trucks or vehicles. Serbia offers the self-propelled howitzer 122 mm SORA, which integrates the famous 22 mm D-30 on a 6x6 truck.

The Algerian Army has installed a 122D30 gun on a Mercedes 6x6 chassis. Sudan offered its version of the Soviet cannon, the KHALIFA GHY02 on the KamAZ-43118 truck. Peru recently intended to equip itself with 122 mm self-propelled howitzers on the AMX-13 chassis.

China has been producing this system for several years for the People's Liberation Army (PLA) and also for export. Norinco produces the PCL-09 or CS/SH1 (Chinese export name), a 122 mm wheeled self-propelled howitzer on a Shaanxi 6x6 truck chassis. It can be ready to fire in less than 90 seconds from transport mode. This gun is in service with the Rwanda Defence Force. There is also the SH2 which is mounted on a lighter 6-wheel vehicle. The SH2 artillery system was first unveiled at the Abu Dhabi International Defense Exhibition in 2007 (IDEX 2007). Nigeria acquired some copies of this equipment, which carries 24 four rounds. It is transportable by tactical aircraft such as the C-130.

The PLA uses equipment such as the artillery truck known as the PLCL-171. Based on Dongfeng Mengshi's CTL 181A 6x6 chassis, the vehicle appears more mobile and agile than a conventional howitzer and can operate in more challenging terrain. With a calibre of 122 mm, the PCL-171 could, however, pay for its lightness with less precision and range than its heavier counterparts like the PCL-161 (122 mm calibre) and PCL-181 (155 mm calibre). This machine should equip lighter and more mobile brigades capable of fighting and moving quickly over various terrains, including the Himalayan plateaus.

155 mm Howitzers

We are interested here in the lightest guns. NATO countries prefer the 155 calibre because its effects are much more devastating than the 105 mm. This calibre has established itself since the 1960s as the best compromise in terms of logistics and military efficiency. Western countries invested heavily over the last 40 years in armoured self-propelled vehicles, which gave birth to the AUF1 on the French side, the PZH 2000 in Germany and the American M-109. This type of equipment is still in production, especially with the Korean K-9 and the Polish AHS KRAB.

The US Army and the Marine Corps used the M198 gun in the aftermath of the Vietnam War, which was then replaced in



LAAD
DEFENCE & SECURITY
2023

11 -14
April | 2023

RIOCENTRO
Rio de Janeiro

THE MOST IMPORTANT DEFENSE AND SECURITY SHOW IN LATIN AMERICA

WWW.LAADEXPO.COM.BR

 /in/laadexhibition

Organización

 **creative**
Events Brazil



American Rheinmetall Munition (Stafford, VA) has been awarded a US\$2.5M contract from the US Army for the delivery of a shorter and lighter artillery weapon system.



Chinese industry has developed highly mobile guns on wheeled vehicles for the PLA and export. It offers 105-, 122- and 155-mm system. Here a PCL-181 firing

2005 by the M777, a 155 mm lightweight towed howitzer. It is a much smaller, lighter, and more manoeuvrable towed cannon weapon than its predecessor, resulting in improved transportability and mobility without impacting range or accuracy. The M777 howitzer has been selected by the US, Canada, Australia, India, and Saudi Arabia. Ukraine received 136 systems, of which the United States donated 108. The M777A2 can use the M982 EXCALIBUR GPS-guided munition, which allows accurate fire at a range of up to 40 km (25 miles). The US Army arsenal modified an M777 with an extra-long barrel in the Extended Range Cannon Artillery (ERCA) programme framework. The modification added 6 feet to the cannon while limiting the increase in

overall system weight to less than 1,000 pounds. The project is designed to extend the range from 30 to 70 km. The programme's ultimate goal is to reach a maximum range of 70 km while minimising the cost and modifications to the weapon platform. The first production of the ERCA programme will be delivered starting in 2025.

The BRUTUS mobile howitzer incorporates patented soft recoil technology like the HAWKEYE 105 mm Mobile Weapon System. The BRUTUS howitzer is fitted with a 155 mm M776 cannon with a maximum rate of fire of five rounds per minute, while the sustained rate of fire is two rounds per minute. Five to seven crew members operate the howitzer based on mission needs for perform-

ing location, firing and displacement. The mobile howitzer can hit targets at a range of 24.7 km with standard ammunition and reach a firing range of 30 km with rocket-assisted projectiles (RAP). It uses all ammunition types which are compatible with the M776 cannon.

Le camion équipé d'un système d'artillerie (CAESAr) has been in service with the French Army since 2008. It exists in two versions: the 6x6 version, which is air transportable without preparation on a C-130, and the 8x8, on an A400M. It is a 155 mm/52-calibre with a range of over 40 km and in service in six countries, including Ukraine, which will receive 18 pieces. Four countries (Belgium, Czech Republic, Lithuania, and Morocco) have already ordered it, and other countries are interested in the system. In February 2022, Nexter was awarded a contract by the French Direction Générale de l'armement (DGA) for developing the CAESAr 6x6 Mark II new generation (N.G.) artillery system. Nexter is currently developing the KATANA shell, which, with GPS and inertial guidance, would increase the range of the CAESAr up to 60 km.

Singapore started to develop an artillery system years ago. The PEGASUS 155 mm 39 Calibre lightweight howitzer is the only 155 mm lightweight howitzer with self-propelled capability, with the French Tr-F1 already phased out. It is air-transportable by a C130 or CH47 and has a unique loading system that lessens the load on the operators and improves firing rates. China offers a lightweight 155 mm howitzer like the towed AH4 howitzer manufactured by Norinco. The AH-4 light howitzer has been developed explicitly for the PLA rapid reaction forces. It can be airlifted by the PLA's CHANGHE Z-18 medium transport helicopter given its relatively light weight of about 4.5 tonnes and is rapidly deployed even in mountainous terrain. It is a 155 mm 39 calibre with a rate of fire of four rounds per minute.

To conclude, highly mobile artillery platforms generated particular interest during the last Eurosatory exhibition. The first lesson of Ukraine's conflict emphasises the prevalence of low-cost UAS systems and advanced sensing capabilities. The consequence is that Russian and Ukrainian forces have been particularly vulnerable to counter-battery fire due to their initial reliance on towed howitzers and artillery pieces.

Light artillery provides one of the answers to the question of fire support for melee units. It should not be overlooked that a deep firing capability is also one of the other aspects of modern combat. ■

Napoléon: “God is on the Side with the Best Artillery”

An ability to focus accurate fires from indirect firing weapons on priority targets still defines the “Best Artillery”. Adding the ability to *shoot-and-scoot* to survive counter-battery fires, ensures battlefield domination.

Heavier, complex self-propelled howitzers were once preferred over lighter artillery. This changed during the past five years. Heaviness is not the only parameter making indirect firing weapons the “King of the Battlefield”. Lighter and more mobile howitzers performed better than heavier legacy systems by the US Army during a “shoot-off” of systems.

Hence, a production-ready howitzer (155 mm) that is more lethal, mobile (wheeled), and survivable is required to replace its legacy heavy, towed howitzer fleet. Enabling lighter indirect firing weapons with the same technical enhancement package of heavier artillery makes them “just as deadly”. Additionally, lightness also reduces logistical strain.

Digitisation of fire control, utilising meteorology data, and updating baseline firing tables with accurate and current muzzle velocity data enables rapid and precise fires from any type of howitzers or even heavy mortars.

Weibel’s muzzle velocity radars (MVR) of the 700-series provide new and legacy artillery with an easily integrated radar system from which data is used by fire



Photos: Weibel

control systems for corrections. From first round fired, the muzzle velocity data will make reducing unwanted dispersion possible, so desired effects are achieved faster with fewer rounds.

Newer propellants and longer tubes increase today’s autonomous mortars range and near-light artillery performance. This necessitates better ballistic control, digitisation, and MVR use – recently considered irrelevant.

Modern lightweight, mobile artillery integrate MVRs – e.g., Hawkeye howitzer. Examining the Hummer CT-2 platform, its

high mobility and fast deployment define it as a system designed specifically for “shoot-and-scoot”. Thus, fire optimisation tools (incl. MVRs) become mission critical. Other applications include the Danish Army’s Cardom 10 mortar permanent MVR mounts and Piranha V APCs installations.

Integrated, digitised meteorological and muzzle velocity data improve battlefield effectiveness, proving victory favours forces with the best artillery.

Weibel’s MVR systems are used on more than 4000 howitzers worldwide in some 30 countries.



You can find more
information here:



Contact:

Finn Kobberø
Regional Sales Director
Mail: fk@weibel.dk
Phone number: +45 20 42 25 11

Mortar Systems Become More Mobile and Effective

Christopher F Foss

Mortar systems continue to play a key role on the battlefield and are often referred to as the infantry battalion commanders' "pocket artillery".

In the past, most mobile mortars were mounted in the rear of tracked and wheeled armoured personnel carriers (APC), fired through the open roof hatches with manual traverse and elevation. Many users are now fitting the platform with an onboard fire control system (FCS) coupled to a land navigation system (LNS) to enable targets to be engaged more rapidly and with greater accuracy. Other developments, especially for larger calibre 120 mm mortars, include power traverse and elevation and a load assist device. Additionally, modern 4x4 vehicles can be equipped with mortar systems, including turret-mounted mortars.

Photo: Thales



Thales 120 mm 2R 2M installed in a Vehicule de l'Avant Blinde (VAB) (6x6) carrying out a fire mission.

Vehicle-Mounted Mortars

China is known to deploy a modified China North Industries Corporation (NORINCO) WMZ551 (6x6) APC, designated as the SM4, armed with a turntable-mounted 120 mm mortar coupled to a computerised FCS. The mortar can fire up to 30 x 120 mm mortar bombs with a maximum range of 7,500 m, which can be increased to 13,000 m by using a rocket-assisted projectile (RAP).

Thales of France (previously TDA) developed their 120 mm rifled 2R 2M turntable mortar system as a private venture. The 120 mm mortar is coupled to an FCS, has an automatic laying system, load assist device and has the same ballistics as the 120 mm MO-120-RT towed mortar system deployed by the French Army. Known export sales of the 120 mm 2R 2M include Italy (FRECCIA 8x8), Oman (modified VAB), Saudi Arabia (upgraded M113A4 APC) and Malaysia (ACV-19). To supplement their deployed 120 mm MO-120-RT towed mortars, the French Army is installing the 120 mm 2R 2M in 54 of their new GRIFFON (6x6) APCs, with the complete system being called the Mortier Embarque Pour l'Appui au Contact (MEPAC). A guided 120 mm mortar bomb with a 15,000 m maximum range is currently being developed.

Photo: STK Land Systems



The 120 mm Super Rapid Advanced Mortar (SRAMS) can be integrated onto a variety of platforms, including the SPIDER

Elbit Systems of Israel took over the complete range of products from Soltam and can now supply mortars and ammunition but also a range of FCS and forward observer systems. As well as marketing conventional towed mortars, they are also marketing their CARDOM 120 mm turntable-mounted mortars which are used by a number of countries including Israel (M113), Portugal (PANDUR III 8x8), and the US Army (STRYKER 8x8). The most recent customer is Denmark which has taken delivery of the CARDOM 10 integrated in their General Dynamics European Land Systems – MOWAG PI-RANHA 5 (8x8) APC. Elbit have recently developed the 120 mm SPEAR which has been shown integrated on the rear of an AM General High Mobility Multi-Purpose Wheeled Vehicle (HMMWV).

Georgia has developed a turntable mounted mortar system called the GMM-120 armed with a 120 mm mortar with powered elevation and traverse and recoil reduction system. As an option, this can also be provided with a digital FCS and a GPS/INS navigation system. To meet the requirements of the Singapore Armed Forces (SAF), STK Land Systems developed the 120 mm smoothbore



Photo: Patria

Patria Armoured Modular Vehicle (8x8) fitted with Patria NEMO 120 mm turret mounted mortar which is already deployed by Saudi Arabia integrated onto a General Dynamics Land System – Canada LAV (8x8)

Super Rapid Advanced Mortar System (SRAMS), which are integrated into the rear unit of the armoured BRONCO all-terrain tracked carrier (ATTC) and more recently a Paramount MRAP (4x4) platform used by the SAF. For trials, SRAMS

has been installed on an STK Land Systems SPIDER light vehicle. Traverse and elevation is hydraulic and it is fitted with a Ring Laser Gyro (RLG), Automatic Fire-Control System (AFCS) and is laid onto the target using a flat panel display (FPD)

We set standard with **FONET**
now watch what we do with
FONET Mk2



Designed to support command, control, communications, computers, cyber-defense, and combat systems integrations.



Complete system integration on a wide range of platforms.



Scalable and modular to support C2 framework system deployment from small units to battalion level and higher.

WB GROUP

FONET Mk2 - Tactical Vehicle Integration Platform

Photo: Christopher F Foss



Spanish ALAKRAN system integrated onto the rear of an Arquus SHERPA (4x4) and fitted with a Thales 120 mm rifled mortar.

and joystick. Further development resulted in the SRAMS Mk 2 with all electric traverse and elevation, with traverse increased to 180° left and right. This is being marketed with a new family of ammunition that includes an HE round with a maximum range of 9,000 m and the GPS PM120 Precision Guided (PG) mortar bomb.

The South Korean Army currently deploys the K242A1 107 mm (4.2 inch) and K281A1 81 mm SP mortars based on the Korean IFV with the mortar firing through open hatches. Under contract with the Defense Acquisition Program Administration (DAPA), Hanwha Defense has completed development of an SP 120 mm mortar system based on the KIFV platform. In the rear, a turntable-mounted 120 mm mortar developed by S&T Dynamics can be rapidly laid onto the target using the computerised FCS coupled to a LNS and features a load assist device.

The United Arab Emirates (UAE) deploys 72 AGRAB (SCORPION) Mk 2 mortar systems, with the International Golden Group as the prime contractor; STK Land Systems provides the 120 mm SRAMS, with Denel Land Systems supplying the RG31 (4x4) Mk 6E mine resistant ambush protected (MRAP) vehicle and Rheinmetall Denel Munitions of South Africa supplying the suite of 120 mm ammunition.

Hirtenberger Defence Europe are marketing the SRAMS Mk 2 together with their family of 120 mm mortar bombs in Europe. This combination was shown at DSEi in London in September 2019.

Further development of the first generation BIGHORN 120 mm mortar by RUAG

Defence resulted in the 120 mm COBRA recoiling turntable-mounted mortar system which is all electric and has been installed in a (GDELS-MOWAG) PIRANHA 3+ (8x8) APC with first firing trials taking place in 2016. Oman was the first customer, with these systems integrated into the FNSS PARS (8x8) APC.

The Swiss Army has recently ordered 32 systems integrated into a PIRANHA (8x8) platform designated 12 cm Mortar 16. It has a computerised FCS and is laid onto the target using a joystick using the FPD on the left side and has a maximum range of up to 9,000 m.

Taiwan developed a Mobile Mortar System (MMS) that can be fitted with a turntable-mounted 81 mm or 120 mm barrel. A first application is installed in the locally developed CLOUD LEOPARD (8x8) APC firing through open roof hatches. The MMS is all electric and can be traversed through 360° with manual back-up and also features a FCS and load assist device.

Aselsan of Turkey possesses extensive experience in the development of turrets, gun control equipment and FCS and has now moved into the mortar market. The first of these is the ALKAR turntable mounted 120 mm which is already in service with the Turkish Gendarmerie mounted in the rear of a BMC VURAN (4x4) MRAP platform. It fires through the open roof hatches and has a load assist device. This system also has all electric traverse and elevation and is coupled to an Aselsan computerised FCS which uses shareable NATO Armaments Ballistic Kernel (NABK) fire control software with a maximum range of up to 8,000 m.

The company recently developed the ALKAR 81 mm smoothbore mortar, using the ALKAR 120 mm mortar previously described but this can be installed on much lighter platforms such as the Toyota LAND CRUISER (4x4). The ALKAR 81 mm smoothbore mortar system includes an automatic barrel laying system, recoil system, computerised FCS and has powered traverse of 180° left and right. Aselsan are quoting a maximum range of 6,400 m.

In early 2019, MKEK unveiled their turntable mounted 120 mm smoothbore mortar system which has a traverse of 360 degrees. The operator is provided with an FPD laying the mortar onto the target using a joystick. It also features a load assist device and a recoil reduction system; MKEK are quoting a maximum range of up to 9,000 m.

To meet the requirements of the Norwegian Army, Rheinmetall Norway developed a turntable-mounted 81 mm mortar system mounted on the Swedish BAE Systems Hagglunds CV90 MULTIC variant based on a refurbished CV90 Mk 1 hull.

A total of 16 CV90 MULTIC vehicles have been delivered, together with 16 kits for each of these allowing it to quickly re-roll according to mission requirements. The 16 kits comprise the 81 mm mortar, cargo carrier, VIP transport and casualty evacuation.

Further development by Rheinmetall Norway has resulted in the recently revealed MWS 120 RAGNAROK 120 mm turntable-mounted mortar system, currently fitted with a smoothbore barrel. This features all electric traverse and elevation and is fitted with a recoil system, computerised FCS and a GPS/INS navigation system.

More recently, the MWS 81 has been installed in the rear mission module of a BOXER (8x8) MRAP and on the Turkish Nurol EJDER YALCIN (4x4) vehicle.

Thales South Africa Systems developed their integrated SCORPION Automated Mobile Mortar Platform as a private venture which has been installed on a number of platforms for trialling, including a Toyota LAND CRUISER (4x4) and the locally developed WASP (4x4) Rapid Deployment Reconnaissance Vehicle (RDRV) deployed by the South African Special Forces (SF). The pallet can be fitted with a turntable armed with a 60 mm, 81 mm or 82 mm mortar or even a rocket system, and fires over the rear arc of 250 degrees. A unique feature of the SCORPION is that it also has an onboard computerised FCS and navigation system with automatic

laying of the mortar tube with a FPD in the cab; according to the manufacturer, "it fires from the back of a vehicle in less than 15 seconds."

Turreted Mortars

NORINCO is marketing two 120 mm SPM systems designated the WMA029 (6x6) and the CS/SM2 (8x8); both have a similar turret with the 120 mm ordnance and as well as an indirect fire capability, also possess a direct fire capability. The 120 mm ordnance is breech loaded with a stated maximum rate of fire of between 6 and 8 rounds a minute with a maximum range of up to 9,500 m. Within the People's Liberation Army (PLA), the WMA029 is referred to as the PLL-05 while the CS/SM2 is deployed by Tanzania and marketed by Poly Technologies as the Type 07PA.

Russia has developed a complete range of SP mortars which they have always referred to as SP gun/mortars because of their direct fire capability.

The first of these to enter service was the 120 mm 2S9 (NONA), which has seen action in Ukraine, based on a modified BMD Airborne Assault Vehicle (AAV) chassis and armed with a 120 mm rifled weapon. The maximum range in the indirect fire role is 8,855 m, but a RAP extends this to 13,000 m and it can also fire a high-explosive anti-tank (HEAT) round for engaging threat AFVs. Some of these have been upgraded to the 2S9-1M standard with new FCS, INS and sensor suite.

The 2S9 was followed by the 2S23 based on a modified BTR-80 (8x8) and has a turret with similar capabilities with some units exported to Venezuela.

The 2S31 VENA is based on a modified BMP-3 IFV chassis, developed to meet the requirements of the Russian Army, but is known to have been exported to both Azerbaijan and Venezuela. The 2S31 has a turret that can be traversed through 360° with the 120 mm 2A80 rifled weapon coupled to an onboard computerised FCS attached to a LNS and day/night sighting system. As well as firing the same suite of ammunition as the older 2S9 and 2S23, it can also fire a new generation of more effective ammunition with a maximum range of 18,000 m.

The Russian Army has also deployed the 2S34, which is essentially a 122 mm 2S1 tracked SP artillery system with the turret mounted 122 mm 2A31 howitzer removed and replaced by the complete 122 mm 2A80 ordnance of the 2S31 VENA. Russia has also recently revealed the 2S41 82 mm DROK mobile mortar based on the TAIFUN K-4386 (4x4) MRAP type and

has a turret with direct and indirect fire capability. The TsNII Burevestnik, part of UralVagonZavod, is quoting a maximum range of up to 6,000 m.

The Russian 2S42 LOTOS is the replacement for the older 2S9 and is also armed with a turret mounted 120 mm rifled weapon based on a new amphibious chassis.

Another Russian development is the 120 mm PHLOX designed by UralVagonZavod as a "self-propelled artillery system." This is based on a 6x6 cross country chassis with the engine compartment at the front, pro-

Advanced Mortar System (AMOS) was developed by Patria (Finland) and the BAE Systems Hagglunds (Sweden), but Sweden pulled out of the programme. In the end, Finland took delivery of 18 AMOS systems and these are integrated onto the roof of a Patria AMV used by the Finnish Army as an APC.

Patria are now concentrating their marketing on their 120 mm smoothbore NEMO (New Mortar), developed as a private venture. Traverse is 360° and its automatic loading system gives a maxi-



Photo: BAE Systems

The Swedish Army has taken delivery of 40 MJÖLNER twin 120 mm turret mounted mortars integrated onto a BAE Systems Hagglunds CV90 chassis

tected four door cab in the middle and the 120 mm ordnance at the rear firing standard 120 mm mortar bombs.

Poland operates a large fleet of Finnish Patria 8x8 Armoured Modular Vehicle (AMV) manufactured under the local name of the ROSOMAK (WOLVERINE). Variants include one fitted with the locally developed HSW 120 mm RAK turret mounted mortar, called the M120. The breech loaded 120 mm mortar can carry out direct and indirect fire missions and in the latter role a maximum range of up to 10,000 m. It is fitted with a computerised FCS coupled day night sighting, INS + GPS and OBRA-3 SSP-1 laser warning system.

To meet the potential requirements of Finland and Sweden, the twin 120 mm

rate of fire of 10 rounds/minute, sustained rate of fire of six rounds a minute and up to five rounds MRSI. The first customer for the 120 mm NEMO was the Saudi Arabian National Guard (SANG). A total of 36 have been installed on their General Dynamics Land Systems – Canada LAV (8x8) while the UAE has installed them on a coastal defence craft. NEMO has also been demonstrated in the US to meet a potential US Army requirement for a Future Indirect Fire Turret.

In December 2016, the Swedish Defence Material Administration (FMV) awarded BAE Systems Hagglunds a SEK575M (US\$68M) for 40 twin 120 mm SP mortar systems called MJÖLNER (Thor's Hammer) fitted onto stored 40 CV90 platforms



Photo: FNSS

Oman has taken delivery of a batch of these FNSS PARS III (8x8) vehicles fitted with the Swiss RUAG Defence COBRA 120 mm recoiling turntable mounted mortar system.

which have now been delivered. In early 2022, another 20 were ordered for delivery by 2025. The turret is armed with twin 120 mm smoothbore muzzle loaded mortars fed by a mechanical handling system with four rounds able to be fired in about eight seconds. Maximum range firing unassisted 120 mm ammunition is 9,000 m and up to 56 x 120 mm mortar bombs are stowed in the bustle and up to 48 in the chassis. An INS is fitted and there is growth potential to add a computerised FCS.

Mobile 4x4 Mortars

A recent development concerns the Spanish EXPAL Integrated Mortar System, or EIMOS, which can be mounted on the rear of light platforms such as the Spanish URO VAMTAC (4x4). EIMOS was developed as a private venture and is armed with an 81 mm mortar fitted with an elastic recoil system based on hydro-pneumatic technology. Optionally, a 60 mm mortar can be installed instead. Maximum range depends on the calibre of the mortar fitted but EXPAL are quoting a maximum range of 6,200 m for the 81 mm version and 4,900 m for the 60 mm model. EIMOS uses GPS for position location but also has an INS and a meteorological station to increase accuracy. It is in service in the Middle East (Bahrain) in the 81 mm version installed on the rear of a VAMTAC ST5

(4x4) platform which also carries 52 x 81 mm mortar bombs.

The latest SP mortar system to be developed in Spain is the ALAKRAN 120 mm Light Mortar Carrier (LMC) developed using internal funding by New Technologies Global Systems (NTGS). This was only launched in 2016 but has already

been deployed by least two countries, with Saudi Arabia taking delivery of 100 units and Ukraine receiving six. The Saudi system is integrated on the rear of a Toyota LAND CRUISER 70 (4x4) while those deployed by Ukraine are integrated into the rear of a locally developed BARS (4x4) APC. When on the move, the 120 mm mortar is stowed in a horizontal position and when required for action, is lowered at the rear until the large baseplate touches the ground. This is powered by an electro-mechanical system which also lays the mortar onto the target using the onboard computerised FCS coupled to GPS and/or an INS. When fitted with a 120 mm smoothbore barrel, the maximum range is quoted as 8,250 m but this could be replaced by a 120 mm rifled barrel or even an 81 mm or 82 mm barrel.

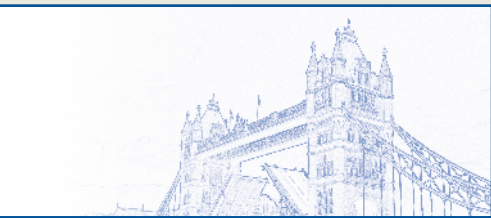
In Paris in mid-2022, the system was shown integrated onto the rear of the Arquus SHERPA and called the A2M Advanced Mobile Mortar with the 120 mm rifled barrel provided by Thales.

Georgia has also developed and tested the DIDGORI MEOMARI 120 mm Mobile Mortar System which is integrated into the rear of their DIDGORI (4x4) light armoured vehicle. When travelling, the 120 mm mortar is stowed within the rear of the hull and when required is lowered to the ground complete with its baseplate and bipod. The 120 mm smoothbore mortar has a maximum range of 7,100 m. ■

Photo: Aselsan



Turkish BMC VURAN (4x4) MRAP fitted with Aselsan Alkar turntable mounted 120 mm mortar during qualification trials



Viewpoint from London



Photo: author

What a Week...

Tim Guest

While, at time of writing, Her Majesty Queen Elizabeth II has yet to be interred alongside her husband, the late Duke of Edinburgh, at St George's

Chapel in Windsor, by now dust will have settled and 'normality', whatever that word means in today's UK, will have returned. This Letter from London was to have focused on 'Changes at the Top', aka the 'political top', the handover of the UK's Premiership from Boris Johnson to Liz Truss, and its implications. However, changes at the top are no longer the preserve of just the Premiership.

On 5 September, a protracted and painful political process came to long-awaited fruition with the choice of Liz Truss as the new Prime Minister. Three Conservative PMs in just six years. The following day, her predecessor flew to Balmoral Castle to tender his resignation to The Queen, with Liz Truss' plane in hot pursuit, no doubt doing its best to avoid the wake turbulence left behind by the former PM - of which there was, likely, plenty. The new PM was then formally appointed by Her Majesty in a photographed moment in history, the Monarch, despite looking a little frailer, appearing in good spirits and performing, what turned out to be, her final state duty.

In the 36 hours that followed, the country focused on the political matters to hand; an energy crisis largely resulting from Putin's actions against Ukraine - and Europe - facing a population already weary from incompetent politicking. Alarming energy-bill escalation has filled the people and businesses with fear of a cold winter ahead, though Truss has proffered an energy-cap solution, which may help some. Then the war in Ukraine, with its forces making great gains, at time of writing; will the new PM continue the resolute support shown by Boris Johnson? It seems so, her first call with a foreign leader was with President Zelensky just hours into her premiership and in which she accepted an invite to visit Kyiv. Ukraine policy continuity was further assured by retaining Ben Wallace as Defence Secretary, whose experience and efforts under PM Johnson were fundamental in Britain's support so far. Wallace backed Truss partly because she's also set her sights on a 3%-of-GDP defence-spend by 2030. In relation to issues facing the UK - Ukraine, Putin, the Northern Ireland Protocol impasse with EU, the energy crisis - Wallace said she was: "the only candidate who has both the breadth and depth of experience needed to confront these challenges". Let's hope he's right, there actually isn't much time to get things right and, certainly, none to get things wrong.



Photo: Jack Lucas Smith via Unsplash

As if that wasn't a busy enough week at the top, then came Her Majesty's passing. For Truss, she found herself, after just two days as PM, shaking hands with a new Monarch and Commander in Chief of the Armed Forces, King Charles III. There can hardly have been a week like it in British history, a new PM on Tuesday, and a new King by Thursday.

As for HM Queen Elizabeth II, she reigned for 70 years, the longest of any British Monarch. She had been a Queen of immense capabilities. Inscrutable though never aloof, majestic, as well as motherly to her nation and nations across the world. She rose above national politics and her stature was felt beyond UK borders, with a global Britain embodied by everyone's Queen. As President Macron said in his wonderfully moving and heartfelt speech, delivered in English to the British people, "To you, She was your Queen. To us, She was The Queen." ...Bravo Macron!

She came to the throne when Stalin still ruled the Soviet Union and Mao Zedong the PRC and even today's leaders of those two adversarial nations, Vladimir Putin and Xi Jinping, sent messages of condolence, so influential and empathic were her diplomatic skills to have had such lasting impact on even the coldest, most belligerent of hearts.

Her passing is the end of an era. What unfolds as a result can only be surmised. Will Scotland, for instance, remain in the UK? With Scottish crowds 20 deep turning out to say farewell, one might be forgiven for thinking that might not happen. Will Australia become a republic, no more British Monarch as head of state? Maybe. New Zealand's Jacinda Ardern, however, has made clear that NZ won't do that, as long as she's in power. As time passes, what unfolds as a result of these historic events may be monumental. The new King has His hands full, as does the new PM.

Liz Truss has taken over at Number 10 Downing Street at a time of political doldrums and a major European war. She's been knocked off her immediate path, unavoidably, by sad events. In the weeks ahead, she must, nevertheless, make the right decisions for the country, its defence and its people.

...What a week.

Ground-Based Hypersonic Weapons

Sidney E. Dean

The two defining attributes of hypersonic weapons are flight speeds of at least Mach 5 (circa 6,000 kph), and in-flight maneuverability. These attributes make hypersonic weapons more difficult to detect and intercept than either conventional cruise missiles which are highly maneuverable but fly at subsonic speeds or ballistic weapons which achieve hypersonic reentry speeds but fly on a fixed, predictable trajectory.

There are two different categories of hypersonic weapons: Hypersonic Glide Vehicles (HGV) and Hypersonic Cruise Missiles (HCM). HGVs are launched atop a carrier missile, much like standard ballistic warheads; after separation from the missile, they transition to an unpowered glide mode for the rest of the mission. Compared to ballistic weapons, separation and transition to re-entry mode occur at a much lower apogee, making detection by long-range surveillance radars less likely. Once on track to target, they can repeatedly change course to evade air defence systems. Operational characteristics of HCMs for their part are similar to those of other cruise missiles, albeit at much higher speeds which are achieved through use of scramjet engines.

United States Hypersonic Aspirations

Their characteristics make hypersonic weapons particularly valuable in the con-

text of major power conflicts, as well as in scenarios involving lesser powers which might own weapons of mass destruction or other mobile high-value targets which must be eliminated quickly. Several nations are currently pursuing hypersonic capabilities. Among western nations, the United States has the most advanced research, development, test and evaluation (RDT&E) programmes which could lead to operational weapon systems. The FY 2019 defence authorization act accelerated development of hypersonic weapon systems, which the Pentagon now categorizes as a priority. The US defence budget request for FY 2023 (1 Oct. 2022 – 30 Sept. 2023) would increase the hypersonic research budget to US\$4.7Bn up from US\$3.8Bn in FY 2022. Additionally, funding for testing infrastructure for innovative technology – including hypersonics – is being boosted by US\$800M. Congressional authorisation seems assured, as offensive and defensive hyper-

Photo: DARPA



The first OpFires flight test achieved all test objectives, including first ever use of a USMC logistics truck as a medium-range missile launcher.

Credit: Lockheed Martin



A graphic rendition of a Hypersonic Glide Vehicle re-entry designed by Lockheed Martin to illustrate the US military's HGV.

sonic weapons programmes enjoy bipartisan support on Capitol Hill.

The Pentagon is currently pursuing RDT&E programmes leading to development of air-launched, sea-launched and ground-launched hypersonic weapon prototypes with shorter to intermediate ranges. All US research programmes are oriented toward non-nuclear weapon systems. This article will focus on ground-launched hypersonic weapon programmes.

US Army LRHW

The US Navy and the US Army are both pursuing HGV concepts customised to the respective services' operational requirements. The Navy is responsible for the developing a common hypersonic glide body (C-HGB) to be manufactured by Dynetics; it is incorporated into both services' weapons

designs. In addition to the warhead, it will incorporate the guidance system, cabling, and thermal shielding. To complete the weapon system, the C-HGB will be paired with an 87.6 cm diameter, two-stage booster rocket to form a vertical-launch All Up Round (AUR) for use by both services. The C-HGB will not include an explosive payload but will destroy its target through the kinetic energy of the warhead's high-speed impact. The chosen operational concept will require extreme precision, especially when contrasted to the option – under consideration by several nations – of deploying hypersonic missiles as theatre nuclear weapons.

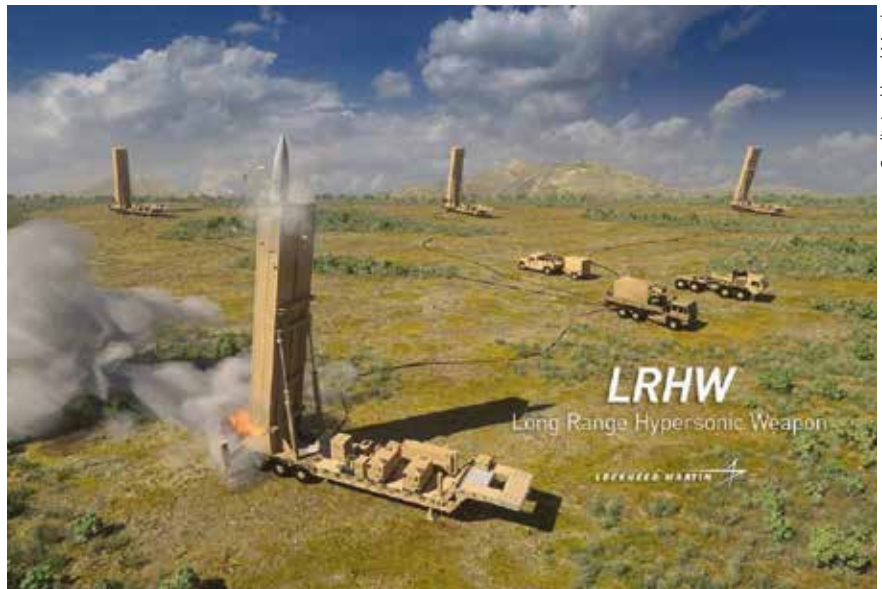
While the Navy plans to deploy hypersonic weapons aboard submarines and destroyers, the Army is seeking a vehicle-based, ground-launched capability. Lockheed Martin is acting as systems integrator for the ground-based variant which is designated as the DARK EAGLE Long-Range Hypersonic Weapon or LRHW. The Army described the range as “well over” 2,775 km; speed is expected to reach just over Mach 5. According to the Army's FY 2022 budget estimates justification book for RDT&E, the programme will “provide the Army with a prototype strategic attack weapon system to defeat A2/AD [anti-access/area denial] capabilities, suppress adversary long range fires, and engage other high payoff/time sensitive targets.”

Current planning calls for a LRHW battery to field four truck-mounted launchers, with each launcher carrying two missiles. A mobile battery operations centre, crane-equipped logistics vehicles for reloading the launchers, and various additional support vehicles will round out the unit. The Army



Photo: US Navy

Concept graphic showing a deployed LRHW battery.



Credit: Lockheed Martin

Concept graphic showing a deployed LRHW battery.



XENTA

TAKE BACK TIME

SHORAD RADARS

The Optimal Radar Solution for Short Range Air Defense

WEIBEL
DOPPLER RADARS



weibelradars.com



Configuration of the LRHW system and ToA of an operational battery



The Common Hypersonic Glide Body



Static test of the LRHW solid-fuel rocket booster

plans to utilise the existing Advanced Field Artillery Tactical Data System (AFATDS) for command and control. The system can be airlifted into theatre by C-17 aircraft. While off-road capable, the tractor-trailer combination launch vehicle is approximately 24 metres long, with the inherent limitations on manoeuvrability. It is primarily intended to be road mobile, switching locations frequently to threaten enemy assets from varying directions while evading counterfires.

Testing and Fielding the LRHW

The first designated DARK EAGLE battery is assigned to the 5th Battalion, 3rd Field Artillery Regiment (5-3 FA) stationed at Joint Base Lewis-McChord, near Seattle, Washington. The 5-3 FA is part of the US Army's 1st Multi-Domain Task Force (MDTF), which was formed in 2017 to test new technologies and operational concepts with a fo-

cus on defeating enemy A2/AA networks. The unit received its full complement of LRHW ground support equipment, including launcher vehicles, in 2021. The initial kit included inert training canisters in place of the AURs, which are still undergoing final development and testing. The training canisters have the same dimension and weight as the AUR, to allow soldiers to become accustomed to handling the weapon system under realistic conditions.

The 5-3 FA is expected to receive AURs during FY 2023 and achieve a limited operational capability by the end of that year. This would make the LRHW the first hypersonic weapon system to become operational with the US armed forces. That being said, the LRHW being delivered to the 5-3 FA in FY 2023 will still be classified as prototype.

"Our goal is to deliver a prototype that soldiers can use and the mission requires that is deemed safe and that the Army can leverage as a potential baseline for a programme of record," said Rob Strider, the civilian head of the Army's hypersonics projects office, in October 2021.

Testing and evaluation of the LRHW in its full AUR configuration will continue through late FY 2022, with a final certification test flight likely to be conducted in the second quarter of FY 2023. In November 2021, Lt. Gen. L. Neil Thurgood, the US Army's Director of Hypersonics, Directed Energy, Space and Rapid Acquisition, stated that these advanced tests will be conducted by personnel of the 5-3 FA. "Those flight tests will actually be done by the unit," Thurgood said. "They'll come to the flight test, they'll shoot off of their equipment and we'll use those flight tests to train the unit as they get ready for the completion of their fielding." Having operational personnel conduct the advanced testing is intended to ensure that all field-relevant factors are considered when evaluating the weapon system's performance.

Transition from a developmental and evaluation programme to an acquisition programme of record is planned for FY 2024. The second and third batteries are to be fielded, respectively, in 2025 in Germany and 2027 at a yet undetermined Pacific theatre location. To date a total of five batteries are planned, one for each of the Army's Multi-Domain Task Forces. Acquisition plans beyond these five batteries have not been finalized. Technology insertion upgrades for the fielded LRHW mission systems have already been planned for both 2026 and 2027; planned upgrades include the ability to remotely reprogramme or update targeting data after launch, to enable engagement of moving or relocated targets.

DARPA OpFires

The Defense Advanced Research Projects Agency (DARPA) is pursuing multiple hypersonic research programmes. One of these, conducted in conjunction with the US Air Force, is an ongoing test series of an air-launched Tactical Boost Glide (TBG) hypersonic vehicle with a Mach 7+ capability. DARPA's Operational Fires or OpFires programme leverages some TBG technologies to develop a medium-range ground-launched tactical system. In February 2022, Lt.Gen. Thurgood confirmed that the Army's Rapid Capabilities and Critical Technologies Office is also involved in the project.

The government has partnered with Lockheed Martin as prime contractor. The first two programme phases ran 2018–2020 and involved design and refinement of the booster system, including static fire tests. Of note is OpFires' second-stage booster motor developed by Aerojet Rocketdyne. It can be throttled or turned off on command, a novelty on solid fuel motors. This has the advantage of enabling the weapon to rapidly and directly strike targets well short of its maximum range without having to perform bleed-off flight manoeuvres.

The third and final phase of the RDT&E programme is dedicated to weapon system integration and runs through the end of FY 2022. It will culminate in integrated end-to-end flight tests to demonstrate system-level critical design maturity. DARPA did not request funding for FY 2023, implying the goals of the research will have been reached. The first flight test was conducted on 13 July 2022 at the White Sands Missile Range in New Mexico. OpFires was launched from a US Marine Corps (USMC) logistics truck utilising a US Army artillery fire control system. According to a DARPA press release, the test demonstrated integrated technology maturation of key enabling components including the first stage rocket motor, missile canister, and missile round pallet (MRP). "Our successful agile hardware development approach prioritises full-scale flight testing that will inform further design maturation this year," said Lt. Col. Joshua Stults, DARPA programme manager for OpFires.

There are no current plans for an acquisition programme of record, although this could change. With a presumed range of circa 1,600–1,800 km or more, Opfires would be well suited to replace the Army Mid-Range Capability (MRC) weapon system which is expected to enter service in late FY 2023. OpFires could be deployed by both the Army and the USMC. The off-road capable system could be transported per C-130 or by amphibious landing craft to prepared and unprepared launch zones in order to maximise tactical flexibility. The launch containers can deploy on and fire from 10x10 logistics trucks already used by the Army and USMC, without special equipment. Nor does a battery require radars or other specialised support vehicles. This would make it particularly attractive to the USMC which is developing highly mobile littoral combat regiments optimised for fast insertion and extraction of a variety of small units including rocket and missile artillery. Unlike the LRHW, OpFires is not restricted to kinetic effects, but can accept a variety of payload options, making it suitable for a broad range of hard and soft targets.

Asian Developments

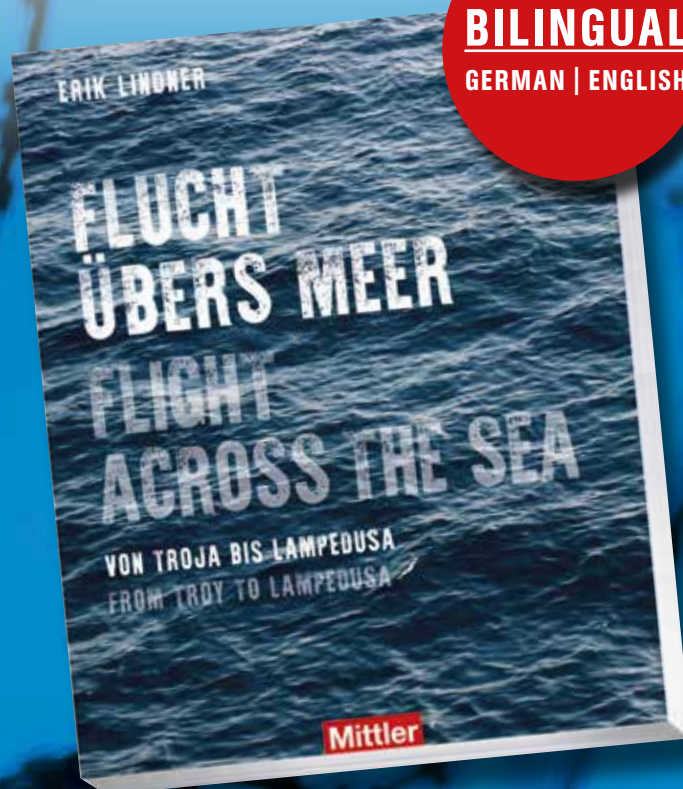
Both Japan and South Korea are developing vehicle-mounted hypersonic ground-based weapons. Tokyo an-

ERIK LINDNER

FLUCHT ÜBERS MEER FLIGHT ACROSS THE SEA

VON TROJA BIS LAMPEDUSA
FROM TROY TO LAMPEDUSA

BILINGUAL
GERMAN | ENGLISH



€ (D) 24,95

ISBN 978-3-8132-0987-7

Order now at
koehler-mittler-shop.de
or by telephone
+ (0)40 / 70 70 80 322



SCAN ME
ORDER NOW!

Mittler
mittler-books.de



The LRHW missiles will be transported on heavy expanded mobility tactical trucks, or HEMTTs, and Transporter Erector Launcher (TEL) trailers, with a combined length of 24 meters.



The tractor will detach from the trailer prior to firing the missiles from the TEL.



Artist concept of a three-missile OpFires configuration firing from the bed of a PLS logistics vehicle in a tropical setting

nounced its plans in May 2020. The Hyper Velocity Gliding Projectile (HVGP) will be boosted by a solid-fuel launcher and will be configured for both land-attack and anti-ship missions. The land-attack payload will consist of multiple explosive formed projectiles designed for area suppression. The anti-ship payload will carry an armour-piercing warhead specifically configured to defeat enemy aircraft carriers and other large-deck vessels. Plans call for a 90° terminal angle of attack to maximize effect on ships. The weapon is expected to have a minimum range of several hundred kilometres.

Development is planned in two phases. The Block I variant will be a comparatively simple design utilising existing missile technology in order to accelerate fielding; prototypes will be tested by Japanese army units. An early operational capability could be fielded on Okinawa as early as 2026 as a front line of defence for the Senkaku islands the nation's Nansei island chain, which stretches some 1,200 km between southern Kyushu and Taiwan; these 198 small southwestern islands include the Senkaku Islands, which are also claimed by China. The Block II variant will be developed using advanced technologies and carry more sophisticated payloads, in what the Japanese MoD has described as a "game changer." Among other advances, the Block II warhead will have a curved beak or "waverider" shape which gains lift through the shockwave generated at the weapon's bow; this will boost speed and range. The ability to strike moving targets such as ships could be introduced with this variant in the late 2020s/early 2030s.

In a separate endeavour, Japan's defence ministry is currently testing scramjet technology to be used in a future hypersonic cruise missile. The weapon is expected to enter service circa 3030, with an improved version available by 2038, but the ministry has expressed interest in accelerating this timeline.

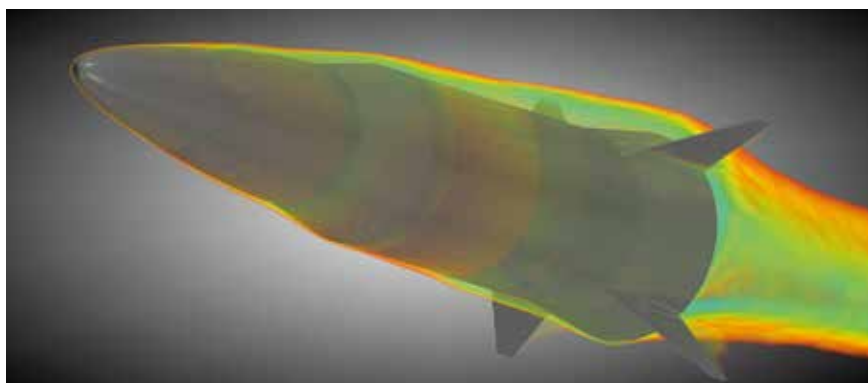
The Republic of Korea (RoK), for its part, presented the model of its Hycore hypersonic weapon technology demonstrator in December 2021. The MoD had announced in 2020 that it recognised a hypersonic weapon requirement as a strategic deterrent against North Korean WMD threats. Unlike Japan or the United States – which are developing HGVs as their ground-based systems – the RoK intends to deploy a ground-based hypersonic cruise missile. The HCM will be launched from a transporter-erector launcher (TEL) using a two-stage solid fuel booster rocket and is expected to reach

Mach 6.2. The technology demonstrator being developed with participation of Hanwha Aerospace, will not have a war-head. Instead, the ramjet powered HCM will mount numerous sensors to collect data during the flight tests, which are expected to be conducted through 2023.

European Interest

France and Germany are taking a different tack with regard to ground-based hypersonic weapons. The future Main Ground Combat System (MGCS) being jointly developed by both nations as a main battle tank replacement is expected to carry a hypersonic effector. MBDA, acting as MGCS prime contractor, is pursuing the hypersonic weapon development. Few official details of the classified programme have been released. First public discussion of this topic dates to a 2019 newspaper interview given by Peter Heilmeyer, the then marketing and business development manager for MBDA Deutschland. He revealed that the German MoD's acquisition agency BAAINBw had initiated a foundational research programme in 2018 to investigate the viability of hypersonic weapons for various applications. Heilmeyer postulated, among other things, that ground-launched hypersonic projectiles would be optimal for defeating reactive armour on enemy tanks.

While the US Army's LRHW seems poised to become the first operational ground-based hypersonic weapon fielded by a Western nation, other services seem determined to follow within a decade. Together with air- and sea-launched variants, hypersonic systems will become integral components of those armed forces whose nations enjoy the technology base and the financial resources to develop them.



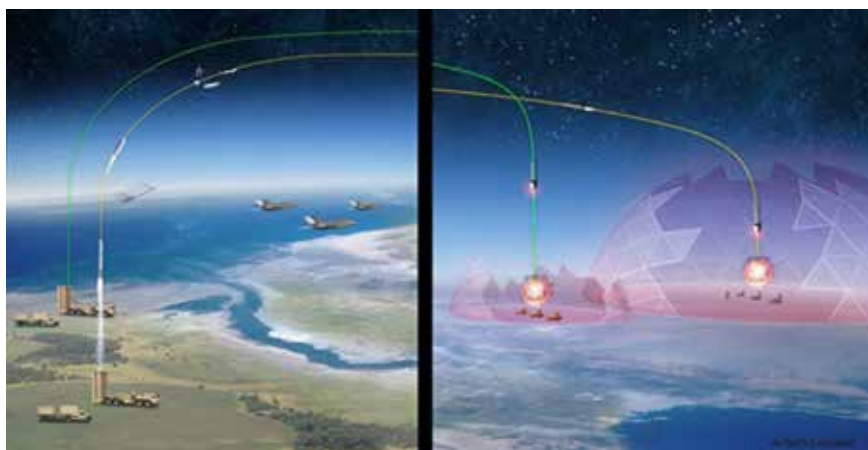
Credit: DARPA

Computer model of the OpFires second stage booster and warhead



Photo: DARPA

A May 2021 static fire test of OpFire's adjustable second stage rocket motor developed by Aerojet Rocketdyne



Credit: DARPA

A DARPA concept showing OpFires in action using a TEL vehicle configuration

BRAVO ZULU

WELCOME TO HELL | WWW.TESTCENTER.SE

WE HELP YOU TO FIND THE
EXACT LIMITS FOR YOUR AMMUNITION AND
WEAPON SYSTEMS – THE HARD WAY.

FUBAIR

BOFORS TEST CENTER

Protection and Security of Water Supplies

Dan Kaszeta

Water is essential to life and health. Therefore, threats to either the supply or quality of water are threats to life itself. Both in military operation and in civil protection, water and water infrastructure are important.

Military operations require a lot of water. Historically, poor water supply has hindered military campaigns and unsafe water has, in some theatres of operation, been as significant a threat to soldiers' health as enemy action. Modern militaries have to devote a significant amount of logistical effort to acquiring and moving water, particularly in expeditionary operations to areas with poor or no domestic water supply. Some military water will need purification, such as drinking water, catering, personal hygiene and medical use. Some other military uses, like engine cooling, construction, vehicle cleaning, and decontamination operations can use non-potable water. Military planning manuals often yield total water requirements of 25 to 60 litres of water, per person, per day, depending on climate. Some armies place great reliance on drilling boreholes, but this is not always the most viable solution. Sometimes existing water from rivers, lakes, and even the sea needs to serve as the solution to water supply issues.

Water Purification

Water purification is essential to remove threats from military water supplies. These threats can be natural ones, such as viruses, bacteria, or parasites that naturally occur, either as endemic threats in an area of operation or as sporadic outbreaks. We should never forget that diseases like cholera and dysentery have historically decimated armies. There are also manmade threats. While deliberate contamination of water with chemical, biological, or radiological threats is theo-

Photo: US Army



Soldiers at Fort McCoy, Wisconsin set up a reverse-osmosis water purification unit, or ROWPU, at Big Sandy Lake

retically possible, far more commonplace threats include accidental contamination with fuel or other pollution sources. It should also be noted that water purification is not just about the safety of the water. Water that tastes poor because of treatment chemicals or other purification methods, even if it technically meets safety standards, is not good for military operations. Soldiers tend to not drink enough water if the water tastes foul, and if food cooked in it smells or tastes bad, it can reduce morale.

Military Water Treatment

The two broad technical approaches for water treatment for deployed military forces. The first is chemical treatment of water. At the absolute bottom end of the spectrum are water treatment tablets, often iodine compounds, that an individual soldier can add to their canteen. For larger operations, hypochlorite or chloramine compounds can be added to larger

containers of water. At the high end, a large military base may end up having a chlorination system not dissimilar to a town or small city installed by a major contractor. Chemically treating water with compounds like iodine or chlorine does pose issues, however. It does not remove anything from the water, so some types of contaminants are unaffected by this method. Further, heavily treated water may have poor taste or smell. The current standard for deployable military water purification is reverse osmosis. Reverse Osmosis Water Purification Units (ROWPUs) are the mainstay of this sector. ROWPUs work by passing dirty water through a membrane designed to allow only water molecules to pass through. In practice, dirty water will foul reverse osmosis membranes over time, so they generally have a number of filters on the front end to remove sand, mud, large particles, and related material. ROWPUs also generally have a single-pass mode or multiple pass modes, referring to the

Author

Dan Kaszeta's is Managing Director at Strongpoint Security Ltd. and a regular contributor to ESD.

number of times the water is passed through membranes.

Reverse Osmosis

ROWPUs do have operational and maintenance issues. Reverse osmosis does not happen without a fair bit of power expenditure, which often gets provided by diesel generators. However, hundreds of litres of water are purified for each litre of fuel used, so this is a net logistical gain. Few ROWPUs are designed for truly continuous operation and they will need maintenance and exchange of consumable items like filters. All generate a waste stream, and in a heavily contaminated environment, this waste may be quite dangerous to handle.

A more thorough review of the military water purification manufacturers and products was in issue 04/2019 of this publication. However, some of the key players in this space are European. ACWA (UK), Stella-Meta (UK), Berkefeld (DE) and Kärcher (DE) are known providers in this space. Ampac, Terra Group, Highland Engineering, and MECO are names in the American market segment. Elsewhere, Tecimer (Turkey), Rowater (Australia), ELW Global (UAE) are also active in this market space. It should be noted that aid work disaster relief means that NGOs and international organisations are significant buyers of nearly identical products.

Chemical treatment and reverse osmosis are relatively mature technologies where improvements come gradually, such as increased efficiency and longer mean



Photo: US Army

US soldiers participating in the Marigliano ROWPU Rodeo on 6 May 2014. The ROWPU Rodeo is held to train ROWPU units in salt water and fresh water operations and build esprit de corps within the ROWPU units.

time between failure (MTBF). But there is an area in military water supply that is a relatively revolutionary technological development. Both chemical treatment and reverse osmosis methods need some source of water to begin with. The frontier in this area is the ability to pull water out of the air. These devices are called "Atmospheric Water Generators." In all but the driest of places on the driest day, there will be the ability to generate some pure water from the humidity in ambient

air. However, doing so does require a lot of power.

Water Gen is an Israeli company that provides commercial systems that extract drinking water out of the air. They have a line of commercial atmospheric water generation systems on the market, several of which could easily be adapted to military requirements. Water Gen's largest system, the Gen-M-Pro, needs a minimum of 20% relative humidity to work. But in humid air, it can pull 900 litres a day out of the air. This is, of course, at the expense of power – it draws 5.6 to 10 kilowatts.

There is military interest in this new field. A US DARPA programme called Atmospheric Water Extraction (AWE) is working with several companies and universities to explore improvements in this area. General Electric (USA) is working on this and calls their experimental product "Air-2-Water". They are half-way through a four-year USD 14.3 million contract with DARPA. Observers of this subject are advised to watch the atmospheric water generation technology segment of the market.

Civil Protection

Protecting civil society from both warfare and terrorism means safeguarding critical infrastructure. A key element in critical infrastructure protection is ensuring that domestic water supplies remain safe from all hazards. This is important in



Photo: U.S. Air National Guard

South Carolina National Guardsmen compete at the ROWPU Rodeo at Fort Story, Virginia, on 15 August 2012.

Photo: US Army National Guard



A water pumps sea water into two ROWPU units near Aguadillas, Puerto Rico, in October 2017. After the ROWPU purified the sea water, more than 100,000 litres of potable water were distributed to hospitals, schools and municipalities in Puerto Rico.

terms of both manmade threats (warfare and terrorism) and natural hazards, such as floods, earthquakes, and other disasters. The Fukushima nuclear disaster provided some concern about radioisotopes in water supplies.

Terrorist use of chemical or biological material in municipal drinking water supplies has long been something that antiterrorism professionals worry about. Large domestic water systems have certain structural advantages, however. The large quantity of water in even a small town's water supply at a given time means that the amount of threat material needed to have appreciable impact is actually quite large, and often impractical. Many chemical warfare agents dissolve poorly in water or hydrolyse into other substances. Furthermore, routine municipal water purification processes and routine quality control monitoring are actually pretty good countermeasures against the majority of technical threats to drinking water. It should also be noted that protection efforts should not just focus only on the supply side of water provision. Sabotage or natural disaster damage to wastewater treatment facilities will also have deleterious effects on the environment, health, and economy.

Maintaining the safety and security of domestic water supplies is an important, if not particularly high profile, aspect of critical infrastructure protection. From a rational threat analysis point of view, the larger threats to drinking water integrity are not covert poisoning scenarios, but more mundane sabotage and vandalism.

Preventing a supply of water purification chemicals, cyber-attacks on the control mechanisms for water purification processes, and actual physical sabotage of facilities or power to those facilities are all far more achievable than some sort of brute force poisoning effort. Vulnerabilities in this area were firmly demonstrated in February 2021 when a cyber-breach threatened the safe operation of a water plant in Florida, USA.

A Robust Supply Chain

Another issue has been ensuring a robust supply chain for water treatment chemicals. Disruptions to trade and commerce have, in various places, caused periodic dislocation in supplies of chemicals, such as chloramine compounds, that are used for municipal water purification. Any holistic approach to security of water infrastructure needs to consider both supply issues and the actual safety of shipments. The security and protection of civil water infrastructure is a valid segment of the physical and cyber security markets, but it is genuinely difficult to find product distinction in this area as the products and services are almost all generic. A CCTV system used at a water treatment plant is not appreciably different than one used for other applications. A number of the major players in traditional physical and cyber-security markets do attempt to address water supply issues.

Some of the developments of note in the civil sector are not necessarily commercial products and services, but pilot

projects and broader integration efforts. The two largest movers in this area are the United States' federal government and the European Union. In the USA, the Environmental Protection Agency has been leading and promoting various efforts. The USA's "National Infrastructure Protection Plan" declares water as one of the sectors of concern and give the EPA national responsibility for it. The "Water Infrastructure Act of 2018" levied a requirement for periodic risk and resilience assessments and the development of emergency response plans for all but the smallest municipal water supplies. The EPA promotes compliance with this and provides technical assistance to local authorities and water providers. In addition, there are a number of US cyber-security initiatives focusing on water systems.

Within the European Union, there have been a number of research and development projects in the area of protection of water and related infrastructure. Broader critical infrastructure projects and programs generally include water in their remit. In recent years, there have been a number of specific FP7, Horizon 2020, and Horizon Europe calls and projects relevant in this space.

STOP-IT was a Horizon 2020 project that ended last year that aimed to provide "an integrated, modular platform that supports strategic/tactical planning, real time operational decision making and post-action assessment for the key parts of the water infrastructure." BIWAS was a short small SME instrument project in Norway that focused on detecting biological threats in water.

FP7, Horizon 2020's predecessor had an entire work programme to improve drinking water security in major municipalities from 2014 to 2016. TAWARA_RTM focused on detection of radioactive material in water supplies. SAFEWATER looked at affordable generic solutions for detecting and managing CBRN contamination in drinking water. ISIS aimed to investigate detecting biological and chemical hazards in drinking water. NATO had a project on "Technical advances to detect and remove contaminants in water for safety and security" in its Science for Peace and Security programme in 2013-2016.

Purifying water, detecting hazards, analysing threats, and providing protection to water infrastructure, both in military environments and in civil society, is an important if often-overlooked sector of defence and security. There will be developments to watch in this sector. ■

ITAR-Related Obstacles to Exports

Manuela Tudosia

The International Traffic in Arms Regulations (ITAR) is known as the strictest export control framework ever imagined. It has caused a lot of ink to flow, and occasionally, even political tensions among allied countries. Two main acts underpin the US' export control policy.

The Arms Exports Control Act (AECT) (1976), implemented by the ITAR, "governs the manufacture, export and temporary import of defense articles, the furnishing of defense services, and brokering activities involving items described on the USML" The latter covers thousands

The Export Control Reform Act of 2018 – superseding the Export Administration Act of 1979 – establishes statutory authority for the control of items and technologies considered to be "dual use", meaning applicable to commercial or military use. The Act is implemented by the Export Adminis-

ity and length of the *United States Munitions List* (USML) but also in some underlying principles that guide its implementation and set it apart.

One of them is the "see-through rule" explained by DDTC as "a colloquial phrase popularly used to refer to the impact of cer-



Photo: pixabay

of articles and related services, including civilian products adapted for military use. DDTC's Bureau of Political-Military Affairs is the primary administrator of ITAR, and is also in charge of designating defence articles and services with the concurrence of the Department of Defense (DoD).

Besides evaluation of export authorisation requests on a case-by-case basis, § 126.1 of ITAR prohibits exports, imports and sales to or from certain countries. This includes countries subject to United Nations Security Council sanctions or countries determined by the US Secretary of State to be state sponsors of terrorism.

tration Regulations (EAR). The Department of Commerce Bureau of Industry and Security (BIS) administers the EAR and maintains the *Commerce Control List* – the list of commodities, technologies, and software controlled by the EAR.

There are many convergence points and similarities between ITAR and EAR, on the one side, and other allied countries' export control regulatory frameworks, on the other. The US – like other countries – aligns its export control regulations with several multilateral export control regimes like the Missile Technology Control Regime (MTCR) and the Wassenaar Arrangement (WA). In these multilateral frameworks, supplier countries seek similar understanding of various aspects related to the enforcement of their export control policies and establish common guidelines. However, this does not prevent diverging interpretations and national discretion when it comes to adopting and enforcing national legislation.

A Daunting Regulation

The scope of ITAR restrictions is vast. The reason for this lies not only in the complex-

ity and length of the *United States Munitions List* (USML) but also in some underlying principles that guide its implementation and set it apart. One of them is the "see-through rule" explained by DDTC as "a colloquial phrase popularly used to refer to the impact of certain ITAR controls". Specifically, based on ITAR §120.6, § 123.1(a) and § 123.9(a) any item described on the USML is a defence article, which requires approval of DDTC prior to the export or temporary import, and "written approval of DDTC before reselling, transferring, reexporting, retransferring, transshipping, or disposing of a defence article to any end-user, end-use, or destination other than as stated on the export license, except in accordance with the provisions of an applicable exemption". What has fuelled many debates is that, moreover, if an ITAR-controlled defence article is integrated into a larger system or end-item, "the defence article does not lose its identity" (DDTC), so it remains subject to control.

Another, very contested, principle is what many authors call "extraterritoriality". The US' export control legislation does not clearly specify the extent of its jurisdictional reach and whether a principle of extraterritoriality applies. However, it contains other references that allude to it and gives broad authority to the President to control the import and the export of articles covered by the legislation.

Author

Manuela Tudosia is government affairs expert in defence, and contributor to the NATO Industrial Advisory Group and NIAG Industry Interface Group. She is also founder of the Pole CM [Civil-Military Innovation Network], initiative that provides strategic advice to Small- and Medium-Sized Enterprises in defence.



Photo: pixabay

The ITAR regulations prohibit exports, imports and sales to or from certain countries.

The practice of extraterritoriality is not unique to the implementation of the export control legislation, but it can be found in the enforcement of other US regulations, for example, in certain international sanctions, in the fight against international corruption, or even in antitrust cases. Its application provides the possibility to apply the same obligations and related sanctions to non-US legal subjects (entities or individuals). Its rationale can derive either from the definition of what a “US person” or a “foreign person” mean in the context of that specific regulation, or – as is especially the case for ITAR and EAR – from the “US nationality” of the article or service being exported. As a result, a so-called logic of “follow the part” applies, whereby any foreign entity that deals with US-origin controlled articles or services becomes subject to the US export control legislation. This adds to potential sanctioning of *any* person (including foreign) who breach certain ITAR provisions, the cases of retransfers or re-exports without authorisation being the most obvious.

Understanding National Dynamics

A good grasp of the potential scope of ITAR-related obstacles cannot be achieved without understanding the national policy dynamics, as well as the relationship between the two main lists – the USML and the CCL.

The two lists are regularly updated to reflect changes in technological developments, but also in US national security and foreign policy interests. The requirement introduced by the Export Control Reform

Act of 2018 to establish an “ongoing process to identify and regulate, as appropriate, emerging and foundational technologies” is a novelty which illustrates the impact that technological developments can have on export control legislation.

As for national security and foreign policy interests, international or national developments can lead certain items to be transferred from one list to another, thus changing the jurisdiction under which they are controlled. Beyond technical considerations that might help distinguish *defence* articles from *dual-use* goods, the two notions could also be used to help distinguish between the jurisdictions under which they are controlled. The potential for an item, technology or service to be placed on the USML can be vast since the evaluation of whether it has *defence* characteristics can be subject to interpretation, to inter-agency consultations, or to more profound political considerations (for example, strengthening vs. liberalising controls according to the threat perception at a given point in time).

For instance, concerns over the flow of satellite technology to China led in October 1998 to the US President signing the *Strom Thurmond National Defense Authorization Act FY 1999* (Subtitle B), requiring that all satellites and related items placed on the CCL to be retransferred to the USML and controlled under ITAR. “Related

items” meant “satellite fuel, ground support equipment, test equipment, payload adapter or interface hardware, replacement parts, and nonembedded solid propellant orbit transfer engines.”

Following the Export Control Reform initiative begun in 2009 by the Obama administration, satellites and related items were removed from the USML and transferred to the CCL by virtue of the *National Defense Authorization Act FY 2013*. With this, “the see-through rule” for satellite export control was also diminished in that satellites which contained parts or components controlled under the ITAR, could remain under EAR control as opposed to automatic ITAR control of the entire satellite.

Impact on Transatlantic Industrial Cooperation

The post-Cold War consolidation of defence industries, cuts in defence budgets and globalisation of supply chains increased the need for multinational industrial cooperation in order to meet several allied countries’ modernisation requirements. While transatlantic industrial cooperation was and remains more necessary than ever, the complexity of export control restrictions, and often heated political debates, do not make industry’s task any easier. The lack of a lasting compromise, fuelled by overly-strong political stances, can hurt industries on both sides of the Atlantic but it can benefit common opponents. Given the current geopolitical situation, one can ask if the following examples from the “pre-COVID times” are still valid.

Among the high-profile examples, the start of the F-35 Joint Strike Fighter programme was paved by difficult ITAR-related discussions with partner nations involved in design and development.

Occasionally, the application of the “see-through rule” was a source of political tensions with certain European allies, especially France. In 2018, Egypt’s purchase of 12 RAFALE fighter aircraft jets – which was made conditional on the acquisition of SCALP missiles – was delayed because the



The US Department of Commerce Bureau of Industry and Security (BIS) maintains the list of commodities, technologies, and software controlled by the EAR.

US refused export of an American component integrated with the Scalp missile. Similarly, the sale of FalconEye military surveillance satellites to the United Arab Emirates was also questioned in 2014 because of ITAR-controlled electronic components.

These types of situations fostered an "ITAR-free movement" in several countries, and even at EU level. Many discussions were held on whether the Future Combat Air System (FCAS) – due to replace both the RAFALE and the Eurofighter – would be ITAR-free. This will probably depend on the political position and the dependencies of all partner nations – France, Germany and Spain. The French Senate 2020 *Information Report on the FCAS* highlighted "a necessary "dis-ITARisation"" and that "from the start, the FCAS project integrates the need to be less dependent on ITAR in the future". For example, the MBDA's MICA missile "is already designed to exclude any ITAR components".

The Franco-German project to develop and produce a next generation Main Ground Combat System (MGCS) may be subject to the same type of discussions. This is particularly due to it being considered as a key project for strengthening European military capabilities, as recog-

nised by the European Parliament annual report for 2021 on the implementation of the common security and defence policy. The report underlines "the need to strengthen EU-US transatlantic cooperation on the basis of an equal partnership" and "stresses the operational dimension of the partnership and the importance of ensuring that the Union maintains its strategic autonomy, in particular as regards the United States' International Traffic in Arms Regulations (ITAR)".

Although France was one of the most vocal in Europe regarding "dis-ITARisation", examples also come from other countries or other European multinational projects. For instance, the German MoD 2017 tender for the acquisition of new assault rifles contained an ITAR-free criterion. An "ITAR-free" ambition was also expressed for the EURODRONE programme, the medium-altitude, long-endurance drone developed for Spain, Italy, Germany and France as customers, which also receives European Union grants.

That being said, it does not mean that European multinational projects that exclude articles or services covered by ITAR (or even CCL) are spared from export control complications. Indeed, aside from general EU regulations, industrial partners need to deal with the national ex-

port control requirements of each country involved in the project. Negotiations between partner countries on the export control framework to be applied to each specific program can also be a source of delays, as much as ITAR.

Changing with the Times

Reforming ITAR was probably on the agenda of nearly every export control discussion in the last 30 years, and even more. One must admit that extending or including ITAR conditions, or opting to go ITAR-free are national or multinational decisions that must be respected. The consequences of such decisions also must be weighed in terms of the richness of knowledge and innovation that can be generated from them. The 1990s gave us respite from Cold War logic, the 2000s brought about new irregular threats, the 2010s heralded the rise of 'hybrid threats', while the 2020s saw the invasion of Ukraine, and a return to a form of Cold War logic. Export controls should obviously adapt to all these changing situations and to technological evolution. As it stands, the current situation will most likely prompt transatlantic allies to sit at the same table and also adapt export controls at the multilateral level. ■

EUROPE AND THE SEA

A CONTINUING STORY



29,95 €
ISBN 978-3-8132-1110-8
Order now at
koehler-mittler-shop.de
or by telephone
+49 (0)40 /70 70 80 322

Scan me & order
now!



Mittler

New Technologies Boost Ground-Radar Capabilities

Doug Richardson

In April 2022, a US Marine Corps (USMC) unit and an air-surveillance radar were moved at short notice from Norway to Lithuania in order to support NATO's air policing mission in the Baltic area. The redeployment from the Arctic to the Baltic was an impressive demonstration of the ability of NATO to provide additional radar capability at short notice to one of the alliance's smaller members, but it is also interesting because the equipment involved was a Northrop Grumman AN/TPS-80 Ground/Air Task Oriented Radar (G/ATOR), a system that incorporates many of the advanced features now being fielded in modern surveillance radars.

A short to medium range multi-role radar intended to detect fixed and rotary-wing aircraft, unmanned air vehicles (UAVs), cruise missiles, and rockets, as well as incoming artillery and mortar rounds, the AN/TPS-80 has a basic configuration consisting of a trailer-mounted radar towed by the Medium Tactical Vehicle Replacement (MTVR), the Communications Equipment Group (CEG) mounted on a High Mobility Multi-purpose Wheeled Vehicle (HMMWV), and Power Equipment Group (PEG) mounted on another MTVR. The complete system is air-portable in a C-130 HERCULES and can be airlifted to its operating location by three CH-53E SUPER STALLION heavy-lift helicopters or MV-22B OSPREY tilt-rotor aircraft.

AESA Systems

Like many modern radars, G/ATOR uses an active electronically scanned array (AESA) antenna. This is based on air-cooled modules but was designed at a time when technology was moving from gallium arsenide (GaAs) hardware to the newer gallium nitride (GaN).

Using two of the low-rate initial production (LRIP) examples, the USMC achieved

Author

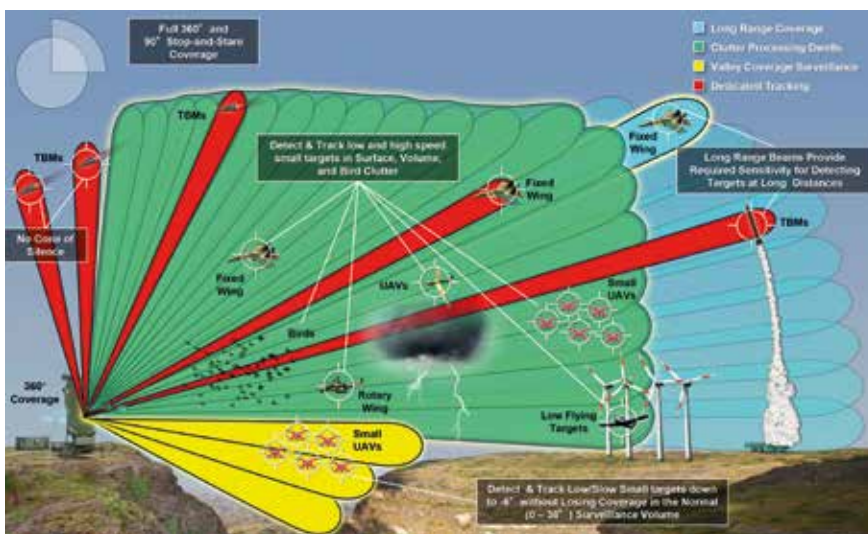
Following an earlier career in engineering, **Doug Richardson** is a defence journalist specialising in topics such as aircraft, missiles, and military electronics.

Photo: Northrop Grumman



Northrop Grumman's AN/TPS-80 G/ATOR was designed to operate in four different roles that in the past would have needed several radars.

Photo: Lockheed Martin



This diagram shows the range of functions that can be handled by the Lockheed Martin AN/TPY-4.

Initial Operational Capability (IOC) of the air surveillance mission in February 2018, while the remaining four were used to establish IOC for the counter-battery mission. All six used GaAs technology, but from the seventh example onwards, the radar used GaN components. Deliveries of this definitive version started in the summer of 2018. G/ATOR will be fielded in several blocks. Block 1 is focussed on the short range air-defence and air-surveillance roles. Block 2 will use software that provides a coun-

terfire capability, with the radar detecting and tracking incoming artillery and rocket projectiles. Block 3 was intended to provide improved performance against more advanced threats, but this variant has been deferred. Block 4 will provide air-traffic control capabilities.

Radar's Role

In the past, a radar's role was largely defined by its hardware, but many of today's



Photo: Lockheed Martin

Lockheed Martin's SENTINEL A4 radar system was designed to detect and track air threats, as well as rocket, artillery, and mortar projectiles.

radars obtain their functionality from software. G/ATOR will perform four principal missions using the same hardware and will rely on software to optimise the system for each mission. Every radar delivered will have the inherent capabilities required for all missions. When all the planned modes are fully implemented, operators will be able to switch between air-surveillance, air-defence, ground-weapon locating, and air-traffic control functions by using the appropriate software. Northrop Grumman has created a digital model of the G/ATOR that will allow new software or engineering changes to be developed, demonstrated, and deployed in a virtual environment prior to being fielded.

In FY 2014, the US launched the Three-Dimensional Expeditionary Long-Range Radar (3DELRR) programme intended to replace the United States Air Force (USAF) AN/TPS-75 radar and the USMC's AN/TPS-59 radar. The new radar would provide long-range surveillance, detection and tracking of air-breathing targets including threats with high manoeuvrability, and those with a low radar cross section (RCS). The threat spectrum also included theatre ballistic missiles (TBMs), so the 3DELRR was also intended to have the capability of determining a missile's launch point and predicted impact location.

GaN Technology

A month after being selected as the winning team, Lockheed Martin completed production of its first 3DELRR radar, which will be designated AN/TPY-4. This is a soft-

ware-defined radar operating in L-Band (1,215 to 1,400 Mhz). Its GaN-based AESA antenna can provide coverage of a 90° sector when stationary, or can be rotated at rates such as 6 rpm in order to scan a full 360°.

A USD 281 million contract to develop the GaN-based SENTINEL A4 air and missile defence radar system was awarded to Lockheed Martin in September 2019. Intended to replace the US Army's current Raytheon AN/MPQ-64A3 air and missile defence radar, it will offer significantly increased performance against fixed and rotary wing threats, cruise missiles, plus the ability to detect and track rocket, artillery, and mortar projectiles, pinpointing the launch site and likely impact locations. The

first prototype for a planned 18 radars became operational in September 2020, five months ahead of planned schedule. An accelerated contract award in October 2021 covered the production of five additional radar systems due to be delivered by the end of 2022 to help the US Army to evaluate its new sensor.

GaN technology is also used in Raytheon Missiles & Defense's Lower Tier Air And Missiles Defense Sensor (LTAMDS) radar being developed to replace the AN/SPY-65A radar used by the PATRIOT SAM system. It uses three AESA arrays to provide all-round coverage, an improvement over the sector coverage of the earlier radar, and has an improved range and an ability to track smaller, faster-moving targets. LTAMDS will operate as a sensor for the US Army's Integrated Air And Missile Defense Battle Command System (IBCS). The first of a batch of six radars due to be delivered to the Army in 2022 arrived at the White Sands Missile Range in April.

Raytheon is promoting LTAMDS as part of a series of radars designated GhostEye, and is offering a GhostEye MR version for integration with The National Advanced Surface-To-Air Missile System (NASAMS). In addition to providing all-round coverage, GhostEye MR will have the range needed to fully-exploit newer missiles such as the Advanced Medium Range Air-To-Air Missile Extended Range (AMRAAM-ER). Under a programme designated AETHER SPY, Northrop Grumman plans to develop the next generation of integrated circuits. Intended for use in advanced AESA antennas, these will make it possible to create a future multifunction radar able to simultaneously perform multiple sensing, communication and electronic warfare functions.



Photo: Raytheon

Raytheon Missiles & Defense's Lower Tier Air and Missiles Defense Sensor (LTAMDS) radar for the PATRIOT surface-to-air missile system uses two smaller AESA arrays to supplement provided by the main array.

Photo: Raytheon



Raytheon's GhostEye family of radars exploit the company's experience with LTAMDS.

Photo: ELTA



Elta's ELM-2084 Multi-Mission Radar (MMR) incorporates surveillance, fire-control, and anti-artillery modes.

Photo: Thales



Thales used GaN technology to create its GROUND MASTER series of air-surveillance radars.

Software-Defined Operation

Features such as GaN technology and software-defined operation are also being exploited by other radar manufacturers. Elta began development of the ELM-2084 Multi-Mission Radar (MMR) in 2002 with the goal of creating a sensor able to detect and track aircraft and ballistic-missile targets. Suitable for installation on a range of platforms, it consists of an S-band radar system, a control module, a cooling unit, and a power generator. The AESA antenna uses GaN technology and can cover a sector of up to 120° by means of electronic scanning but can also be rotated at up to 30 rpm to provide all-round coverage.

When used in the air defence mode, the ELM-2084 is intended to detect and classify all types of air targets, and generate a real-time air situation picture, while a Fire Control Radar (FCR) mode allows it to be used to control surface-to-air and anti-missile systems. An Artillery mode allows the detection of incoming mortar and artillery shells, as well as rockets and missiles, and the radar can identify the location from which these were fired, and their likely impact point. A prototype was used as an early-warning radar during IDF operation "Cast Lead" in 2008, when it successfully detected enemy artillery fire. Three years later an MMR radar was used as the control element of the IRON DOME anti-rocket system.

The basic design has been scaled down to create the ELM-2084 MINI variant designed to deal with shorter range threats. Four MMR modules form the basis of the company's MF-STAR naval radar, which in turn led to the land-based MF-STAR LB based on a single rotating module.

According to Thales, the GM400 ALPHA - the latest member of its GaN-based GROUND MASTER series of air-surveillance radars - has five times the processing power of the previous configuration and uses advanced artificial intelligence algorithms. These features allow the radar to process large amounts of complex data. Detection range is increased, and the radar can detect targets ranging from fast jets and missiles to slow-flying targets such as helicopters and UAVs.

Russia

Russia has developed and fielded low-band radars which it claims can track stealth aircraft, and some Western sources have also claimed that radars operating at such low frequencies can at least partially circumvent current low-observable technologies.

Russia has developed several radar systems that combine subsystems operating at two or more frequencies. In 2013 NNIIRT displayed its 55Zh6UME (also known as the NEBO-UME), a radar that combines two antenna units mounted back-to-back in a single rotating assembly. One operates in the VHF band, the other in L-band.

NNIIRT's 55Zh6M NEBO-M (also available in an export variant designated 55Zh6ME NEBO-ME), uses three antenna units, each operating in a different band – the RLM-M (Radiolokatsionniy modul - metroviy diapazon) VHF (metric) subsystem, the L-band RLM-D (Radiolokatsionniy modul - decimetroviy diapazon), and the RLM-S (Radiolokatsionniy modul - santimetroviy diapazon) based on an X-band AESA antenna. All three are linked to the KU-RLK (Kabina upravleniya radiolokatsionnovo kompleksa) command post, which fuses the incoming data to create a single radar picture. Deployment of the NEBO-M began in 2017, with the first two operational regiments being based at Saint Petersburg and Kareliya.

China

China is also promoting low-band radar as a viable anti-stealth technique. Engineers at the China Electronics Technology Group Corporation (CETC) are confident that they have developed early-warning radars able to detect and track stealth aircraft. At least five radars are claimed to have anti-stealth capability – the JY-26, JY-27, JY-27A, LX-11, and JY-50, along with the Nanjing Research Institute of Electronic Technology (NRIET) YLC-8B. All operate at VHF or UHF frequencies.

The YLC-8B is a medium/high-altitude long-range 3D surveillance radar operating in the UHF band. Its antenna combines 2D electronic scanning and 1D mechanical scanning. Resolution is 150 m in range, and 6° in azimuth at the radar's centre frequency.

The JY-26 SKYWATCH-U 3D long-range air-surveillance radar operates in the UHF band and can cover a 90° azimuth sector when active electronic scanning is used. Mechanical antenna scanning allows it to cover a full 360° in azimuth coverage. According to the CETC, its anti-stealth performance results from a combination of a UHF operating frequency and a large power aperture.

While the antenna of the LX-11 long-range medium-to-high altitude early-warning radar may look at first sight like a design from the 1950s, it is teamed with a solid-state transmitter offering fully-coherent frequency agility. The LX-11 oper-



Photo: Russian MoD

Russia's 55Zh6M NEBO-M uses three antenna units, each operating in a different frequency band. The resulting VHF, L-band, and X-band data are combined to create an integrated air picture.

ates on two frequencies (designated A and B) in the VHF band. Range resolution is 900 m, while the azimuth resolution is up to 7.2° with the A-band, and up to 9.2° in B-band.

Anti-Stealth Capability

These claims of anti-stealth capability cannot be accepted at face value, given that until recently neither Russia nor China will have had the opportunity to use radars of this type against US low-RCS aircraft. Although opportunities to track the F-117, F-22, F-35, and B-2 have occurred, most did not involve aircraft that were flying combat missions. When flying non-combat missions, US stealth aircraft routinely carry omnidirectional radar reflectors that enhance their radar cross-section (RCS). This ensures that the aircraft can be tracked by friendly radars such as air-traffic control radars, but also serves to conceal the aircraft's RCS.

Until recently, the only non-US radar operators with direct experience of trying to track stealth aircraft on operational missions are those from the countries that have been attacked by the F-117, F-22, or B-2.

The only unclassified account seems to have been that of the Serbian unit that shot down an F-117 on 27 March 1999. Commanded by Zoltan Dani, this relied on the Soviet-era P-18 radar as an acquisition aid. The P-18 operates at frequencies ranging from around 150 to 175 MHz, and the Serbian unit operated its radar at the lowest end of this band. (Claims that the unit had modified the set to lower its operating frequency still further are now reported to have been disinformation.)

Under normal circumstances the P-18 can detect a fighter-sized aircraft at a range of 125 to 200 km, but the Serbian unit did not achieve lock-on against the F-117 until the Nighthawk was only 25 km away. This would suggest that the stealth technology of the US fighter was at least partially effective at 150 MHz.

Russia's military intervention in the Syrian conflict finally gave it the possibility of testing its modern radars against the latest generation of US stealth aircraft. The US had begun to use the F-22 against targets in Syria during September 2014, but it was not until late in 2015 that Russia deployed its own latest-generation air-defence assets to that country, including S-400 battery equipped with the 91N6 'BIG BIRD' surveillance radar and 92N6 GRAVE STONE 8-12.5 GHz fire-control radars. F-22 combat operations over Syria in 2016 may have pitted US fighter against these air-defence assets.

In December 2017, Israel declared Operational Capability (IOC) of its first Lockheed Martin F-35 LIGHTNING II, and by May of the following year had conducted combat operations with its new fighter on what it described as "different fronts". It released a photograph showing what appears to be an F-35 flying over Beirut, and one unofficial report claims that several Israeli F-35s have flown deep into Iranian airspace.

But while these operations may have exposed the F-22 and F-35 to unfriendly radars, the operators of these air defences will have no way of knowing if the US fighters were operating at minimal RCS or were using radar reflectors in order to conceal their full stealth capability. ■

Western Solutions for Fire Support Vehicles and Medium Tanks

Luca Peruzzi

Specially developed to support infantry with their firepower, providing direct fire support against enemy armoured vehicles, including main battle tanks, prepared positions and close support through fire and manoeuvre, the most recent fire support vehicle (FSV) platform designs are based on 6x6 and 8x8 wheeled armoured vehicles.

In some cases, these vehicles have a prominent tank destroyer mission, also called Mobile Gun Systems (MGSs), or infantry fighting vehicles (IFV). Both types are equipped with a manned turret with a 105 mm rifled gun, or in some cases, a 120 mm smoothbore gun. An emerging market is growing in some parts of the world for both wheeled and tracked FSV platforms, the latter also known as medium tanks. In the South American region, the Brazilian Ministry of Defence is launching the Viatura Blindada de Combate de Cavalaria (VBC Cav) or Armoured Cavalry Combat Vehicle procurement programme, which is expected to see the participation of US/Canadian, European, Israeli and Chinese companies providing an initial 98 vehicles out of a total requirement of 221. In the US, the Army programme for the Mobile Protected Firepower (MPF) based on a tracked platform is also on the verge of selecting a down-selected contender. The medium tanks also interest the Asia Pacific Region, where procurement is already ongoing or set to be launched, as with the Indian MoD in the latter case, which in early March announced a programme for the development of a new light tank.

CENTAURO II

Since its inception, the CENTAURO 105 mm was developed by the CIO consortium including Iveco Defence Vehicles and Leonardo as a Mobile Gun System (MGS). Based on the operational experience gained with the first generation MGS in service with Italy, Spain, Oman and Jordan, the Italian Army and CIO developed the CENTAURO II, which differs mainly in enhanced mobility, protection, firepower and connectivity. The power-to-weight ratio, increased to 24 hp/tonne, has a positive influence on speed and acceleration performance thanks to the new-

Photo: CIO



Being the first 8x8 wheeled anti-tank vehicle in the world with a high-pressure gun, the CENTAURO II design is based on the operational experience of first generation platform equipped with 105 and 120 mm guns.

generation 720+ hp Iveco engine and modernisation of the transmission, braking and control electronics. The platform and crew protection was improved significantly, with a rearranged hull chassis and turret design, integral add-on ballistics, tested to NATO STANAG 4569 standards, capable of handling threats such as mine, improvised explosive devices (IEDs) and the latest-generation kinetic munitions. With a Gross Vehicle Weight (GVW) of 30 tonnes, the four-man CENTAURO II is equipped with the new Leonardo three-man, fully electric and modular HITFACT Mk II turret, which has improved survivability able to be configured for a third generation 120 mm L45) smoothbore low recoil force gun. The Leonardo fully digital optronic suite includes the multispectral ATTILA D panoramic commander's sight for engaging stationary, moving and airborne targets and the Lothar gunner's 24h sight, together with a new generation communications suite. In addition to a coaxial 7.62 mm machine gun, the CENTAURO II is equipped with a 12.7 or 7.62 mm remotely operated HITROLE light

turret integrated into the vehicle. A total of 106 vehicles are already ordered from a 150 unit requirement, with the first vehicles delivered at the beginning of 2022. The CENTAURO 2 is a main candidate for the Brazilian Army's VBC Cav tender, with Iveco and Leonardo having an important industrial footprint in Brazil for production nationalisation, and with Iveco already involved in Guarani VBTP and LMV production programmes.

SABRAH

In January 2021, the Israeli Elbit Systems company announced a contract award valued at approximately USD 172 million. The SABRAH light tank solution based on the General Dynamics European Land Systems Santa Barbara (GDELS) from Spain and on the wheeled PANDUR II 8x8 platform manufactured by Excalibur Army from the Czech Republic will be supplied to the Philippines Ministry of Defence. The latest generation amphibious PANDUR 6x6 and 8x8 armoured platforms presents a longer wheel base and modified hull compared

to the PANDUR I but with overall platform layout similarities to the latter. The vehicle is fitted with an Automatic Drivetrain Management (ADM) system with sensors that check the drivetrain automatically, which adjusts power for each axle and wheel according to road/terrain conditions. The PANDUR II 8x8 is equipped with a Cummins 450 hp Diesel ISLe T450 HPCR engine offering a 105 km/h maximum speed on roads. Ballistic and anti-mine protection ranges from STANAG 4569 Level 1-to-4. According to Elbit Systems, the SABRAH modular solution enables the use of the same 105 mm turret and other subsystems for the tracked and 8x8 wheeled platforms. The SABRAH package is centred on a two-man fully electric turret equipped with an Elbit Systems Land 105 mm L52 low recoil coiled gun and a 7.62 mm coaxial machine gun combined with a 12-round automatic loader (with a manual backup loading), providing a six rounds per minute rate of fire. Thanks to a sophisticated fire control system (FCS) centred on a commander's panoramic sight, the SABRAH can engage on the move, both stationary and moving targets, alongside hunter-killer capabilities. The mission package also includes the Torch-X battle management systems, E-LynX software-defined radios and life support systems, while the Level 4 STANAG 4569 ballistic protected turret can optionally accommodate two anti-tank guided missiles. The SABRAH package on a 8x8 solution is a potential candidate for the Brazilian tender with Elbit Systems' local subsidiary support, but the platform is reported to be the Israeli EITAN armoured 8x8 vehicle.

LAV 700

The latest development of the LAV (Light Armoured Vehicle) multipurpose armoured wheeled vehicle by General Dynamics Land Systems - Canada (GDLS - C), the LAV 700 leverages the extensive experience gained in a decade of operations with international customers. With a 32 tonne GVW, of which 11 tonnes are payload, the LAV 700 is equipped with a 711 hp Caterpillar C13 engine combined with an Allison 2800 automatic transmission, a fully independent and adjustable hydro-pneumatic suspension, which allows controlling the height of the hull from the ground. The latter is characterised by a double-V design with inherent mine blast alongside scalable ballistic protection with anti-RPG nets, Explosively Formed Projectile (EFP) modules and capable to accommodate both passive and active protection system. The LAV 700 platform has been integrated and is already under production in a Fire Support Vehicle (FSV) version equipped with the John Cockerill Defense (JCD) modular C3105 turret. The two-man electrically-driven turret is equipped with a Cockerill 105 mm HP gun capable of using the full range of NATO standard munitions, as well as firing anti-tank missiles, combined with an automatic loading system with 12-to-16 rounds depending on customer requirement. With a coaxial 7.62 mm and a pintle mounted or remotely controlled machine gun, the gun has an elevation capability of +42° providing a greater field of fire in urban environments against dismounted threats

Photo: Elbit Systems



The Israeli Elbit Systems company will provide its new SABRAH missions package with a new turret on the wheeled PANDUR II 8x8 platform manufactured by the Czech Republic's Excalibur Army company to the Ministry of Defence of Philippines.

engaging from upper building floors. With eight smoke launchers and a ballistic protection up to level 5 STANAG 4569, it can be equipped with active protection systems (APS), laser warner, anti-sniper detection, among other protection systems.

BOXER

With approximately 1,500 vehicles under contract with six countries including Germany, the Netherlands, Lithuania, UK, Australia and more recently Slovenia, the BOXER 8x8 multi-role armoured wheeled vehicle is developed and produced by the international ARTEC industrial consortium of Krauss-Maffei Wegmann (KMW) and Rheinmetall, and managed as a multinational programme by the OCCAR agency. The vehicle is characterised by a distinctive and unique feature: it is composed of a drive platform module and interchangeable mission modules, which allow several configurations to meet different operational requirements. With a typical combat weight ranging from 31.5 up to 38.5 tonnes and a 13.5 tonne payload, the BOXER is characterised by high survivability thanks to proven protection against ballistic threats, integrated and versatile protection packages, including the Rheinmetall Active Defence System (ADS). Thanks to the modularity concept, additional ammunition and crew equipment can be accommodated in the rear of the mission module.

Photo: CIO



The CENTAURO II is equipped with the new Leonardo three-man, fully electric and modular HITFACT Mk II turret with improved survivability, which can be configured for either a third generation 120/45 mm or a 105/52 mm gun.

AMV XP

The Patria AMV XP is another 8x8 armoured wheeled vehicle offered in a FSV version although no customer has so far acquired the vehicle in this configuration. However, it has been successfully integrated in 2018 and subsequently tested in live firings with a Leonardo HITFACT turret equipped with a 120 mm smoothbore gun, as well as with the JCD CT-CV 105HP turrets with the same company's 105 mm rifled gun. Today, the vehicle is reportedly being promoted with the latest generation modular C3105 two-person turret for the Brazilian programme, being the AMV XP inherently designed to be able to accommodate various types of turrets and payloads.

US MPF Programme

The US Army is about to select the winner of the Mobile Protected Firepower (MPF) programme. The latter supports the production and fielding of the MPF tracked vehicle, which will provide the Army's Infantry Brigade Combat Teams (IBCTs) a protected, long-range, precision direct-fire capability to ensure freedom of movement during offensive operations and defeat attacking enemy during defensive operations. Under rapid prototyping contracts assigned in 2018 to BAE Systems and General Dynamics Land Systems (GDLS), each company provided twelve pre-production MPF vehicles for developmental, operational testing and soldier vehicle assessment which was concluded in early 2Q FY 2022. With

Photo: KWM/John Cockerill Defense



An Artec BOXER FSV version was tested by KWM with internal funds by integrating the modular JCD C3105 two-person turret with the same company's Cockerill 105 mm HP gun into a rear mission module of the vehicle.

selection and contract award to begin low-rate production in 2022, the MPF vehicles fielding is planned for FY 2025, with a total requirement of 504 vehicles.

The BAE Systems proposal derives from the M8 design conceived for the cancelled US Army's Armoured Gun System (AGS) programme to replace the M551 SHERIDAN air transportable light tank, whose role from a firepower perspective was largely covered for the IBCTs by the GDLS-built M1128 STRYKER Mobile Gun System (MGS), due to be retired by end FY 2022. Maintaining the size, weight - indicated in the low- to mid-20-tonne range - and footprint of the AGS offered platform, three fully armoured BAE MPF vehicles are capable to be carried inside the C-17 GLOBEMASTER III transport aircraft, while a single platform with the armour removed can be airlifted by a C-130 HERCULES. Equipped with an undisclosed rear-mounted new turbo diesel engine from MTU, traditional torsion bar suspension, but using a composite rubber track providing low vibration and rolling resistance with better fuel consumption, the BAE's MPF maintains a three-man crew (commander, gunner and driver). Its turret is equipped with a 105 mm NATO-standard M35 low recoil gun as requested by the US Army and an autoloader allowing a gunfire rate of 12 rounds per minute, alongside a coaxial 7.62 mm and over turret 12.7 mm. It also integrates scalable bolt-on armour packages and innovative survivability subsystems while vehicle employs situational awareness systems with sensors derives from US Army programmes.

The General Dynamics Land Systems MPF vehicle is a combination of the chassis based on the UK AJAX family of light armoured vehicles with a downsize version of the M1A2 ABRAMS turret design and elements of its GRIFFIN tank demonstrator. It is powered by a front-mounted diesel engine coupled with a fully automatic transmission providing high power-to-weight ratio with extended tactical range. The hydraulic pneumatic suspension allows for higher cross-country mobility. The platform will ride on traditional steel tracks using lighter

road wheel design with improved durability, lower noise and vibration. With a four-man crew, the platform's turret is equipped with a 105 mm NATO-standard M35 rifled low recoil gun as required by the US Army, with a manual loader, leveraging on the ABRAMS M1A2 System Enhancement Package (SEP) V3 fire control system (FCS) package, a Safran PASEO commander independent sight and a Raytheon gunner's Primary Sight. Although very little information was released on the issue of protection, the vehicle is designed to accommodate scalable armour, equipped with a Metravib Defence PILAR V acoustic crew warning system and capable to receive an active protection system (APS). With a GVW reported at less than 40 tonnes, two vehicles can be fitted inside a C-17 transport aircraft.

HARIMAU

Last March, the Turkish FNSS group announced it had delivered an initial batch of ten HARIMAU ('White Tiger' in the Indonesian language) medium tanks to the Indonesian Ministry of Defence within the scope of the same KAPLAN (as called in Turkey) combat platform serial production long-term collaboration agreement signed between FNSS Savunma Sistemleri and Indonesian PT Pindad companies in 2019. Under the latter, FNSS completed the production of the initial batch of 18 vehicles in the serial production configuration. The remaining eight new production tank platform hulls were shipped to Indonesia for final turret assembly and delivered to the Indonesian Army after the final acceptance stage. Developed by the latter company, PT Pindad and John Cockerill Defense to meet the Indonesian Army's requirements, the HARIMAU consists of a new platform based on the FNSS Armoured Combat Vehicle-30 (ACV-30) fitted with the JCD C3105 three-man turret equipped with the same company's high pressure 105 mm rifled gun and a coaxial 7.62 mm machine gun. A computerised FCS is fitted with independent stabilised day/thermal sights

Photo: John Cockerill Defense



The GDLS Canada's LAV 700 platform has been integrated and is under production in a Fire Support Vehicle (FSV) version equipped with the John Cockerill Defense (JCD) modular C3105 turret with the same company's 105 mm gun.

for the commander and gunner with high first-round hit probability. With a GVW of 30 tonnes and a power pack based on a Caterpillar 700 hp diesel, the HARIMAU can reach a maximum speed of 70 km/h. Other features include an auxiliary power unit ensuring the availability of continuous power with reduced signature during night operations where the vehicle operates mostly in a static position, land navigation system, battle management system and laser warning system. The Indonesian Army has a total requirement for up to 400 HARIMAU tanks to replace the depleted fleet of French-made AMX-13 light tanks, with more opportunities potentially coming from export in the Asia-Pacific region.

ASCOD 2

A marketing development of General Dynamics European Land Systems Santa Barbara Sistemas (GDELS) of Spain, the ASCOD (Austrian Spanish Co-operative Development) tracked armoured vehicle platform has already been contracted or is in service in over 1,000 units by four customers. This includes Spain for its PIZARRO IFV, Austria for the ULAN IFV, UK for the AJAX group of armoured fighting vehicles based on the enhanced ASCOD 2 platform, and more recently the Philippines for the SABRAH medium tank. The ASCOD 2 base platform is a continuous evolution of the well-known ASCOD concept, offering advanced protection and mobility, large internal volume at very compact dimensions, and a large payload at low GVW. With a monocoque welded steel hull incorporating the primary common subsystems of the power pack, running gear and fuel, the ASCOD's seven wheel station chassis provides the vehicle the mobility/mine protection characteristics and acts as the interface for all the other primary subsystems. In addition to the armoured steel hull, the ASCOD 2 offers a modular package where ballistic protection is obtained through the add-on protection alongside inside spall liners. In January 2021, GDELS announced that it had been contracted by Israeli Elbit Systems to provide the ASCOD 2 tracked armoured vehicles for a 30-tonne light tank application.



Photo: BAE Systems

The BAE Systems' new generation MPF platform proposal derives from the experience gained with the M8 design for the cancelled US Army's Armoured Gun System (AGS) programme to replace the M551 SHERIDAN air transportable light tank.

The new vehicle, due to be branded SABRAH, will be equipped with the same turret outfitted with a 105 mm calibre-turret and mission equipment package provided by Elbit Systems. The Philippines Minister of Defence later disclosed that the new light tank will be delivered in 20 units.

LYNX 120

Rheinmetall has recently added a mechanised fire support variant of the LYNX KF41 Infantry Fighting Vehicle. Called the LYNX 120, "this unique platform merges a tried-and-tested turret concept and the proven 120 mm smoothbore cannon with the LYNX KF 41 chassis", Rheinmetall announced when unveiling the new variant. The basic idea of the LYNX 120 design concept is to provide a combat system offering maximum operational performance in combination with logistic advantages within a reasonable timeframe at a realistic cost. The vehicle's main armament is a Rheinmetall 120 mm smoothbore gun, derived from the main armament of the LEOPARD 2. It can fire DM11 programmable high explosive (HE) projectiles. Its secondary armament includes a coaxial machine gun. Moreover, the commander's independent weapon station will feature a 12.7 mm machine gun. A 360° camera system with automatic target detection and tracking reduces the crew's workload in all operational scenarios. Special protection modules enable a mission-specific response to ballistic threats, improvised explosive devices, explosively formed penetrators and artillery fire, and can be quickly mounted with limited tools. The LYNX 120 can be also readily equipped with the proven, already fielded Rheinmetall Active Defence System (ADS) to defeat rocket-propelled grenades and anti-tank missiles. Additional armour packages and active protection systems can be provided on request.

CV90120

The CV90120 is a further development of the Combat Vehicle 90 (CV90) IFV family by BAE Systems Hägglunds, centred on the latest marketed iteration on the CV90



Photo: Patria

The Patria AMVXP 8x8 armoured wheeled vehicle has been successfully tested in a FSV version equipped with the Leonardo HIT-FACT turret with 120 mm smoothbore gun, here depicted.



Photo: John Cockerill Defense

The John Cockerill Defense (JCD) modular C3105 turret with the same company's 105 mm gun is achieving international success.

Mk 4 platform fitted with a two-man low profile turret with a Rheinmetall 120 mm low recoil gun. The CV90120 has 26 to over 40 tonnes GVW, and is equipped with a power pack consisting of a Scania diesel with a potential growth up to 1,000 hp. It has an active dumping suspension and a fourth generation NATO-standard electronic architecture. Its hull is matched with a low profile two-man turret equipped with Rheinmetall 120 mm low recoil gun ranging from LLR L47 to L55 models, and a bustle-mounted 16-round autoloader, as unveiled for the first time in 2018, with a coaxial 7.62 or 12.7 mm machine gun. The CV90120 is marketed with a modular armour package, including additional protection against shaped charge warheads, an active protection system (APS) with detection, classification and avoid capabilities and up-scalable from soft-kill to hard-kill effectors. It has seen several conceptual signature management systems in order to show how to mitigate against the limited survivability of light tanks. This includes the BAE Systems ADAPTIV cloaking system, an active thermal masking system that uses a matrix of hexagon Peltier plates to alter a vehicle's thermal signature – thus rendering it invisible within the spectrum – or to present an alternate thermal image such as an animal or non-target vehicle. ■

The Long Road...

Shaun Connors

Oshkosh recently delivered the last of 78 upgraded Medium Equipment Transporters (METs) to the UK Ministry of Defence (MoD) under an approximate GBP 16 million contract. The first of these upgraded trucks have already been used to transport additional British Army armoured vehicles and equipment out to Estonia.

Under a June 2020 post design services (PDS) amendment to the original Wheeled Tanker contract of 2003 and following on from delivery of a 'proof of concept' example, from June 2021 Os-

shkosh was sub-contracted to carry out the necessary work on the trailers, with the work done in the UK by Broshuis' partner, John Hudson Trailers of Bawtry. Work on around 30% of trailers was carried out

converted to work with the in-service LET trailer in the Interim Light Equipment Transporter (I-LET) role. This was necessary since the Seddon-Atkinson 6x4 LET tractor in service at the time lacked the required level of mobility and was unable to accept add-on armour.

The Seddon Atkinson fleet had been delivered from 1992 and was originally coupled to a Trailmaster three-axle stepframe low loader trailer. Trailmaster ceased trading shortly after delivery and owing to ongoing problems with these trailers, a replacement was purchased earlier than planned from Broshuis during 2004. Broshuis supplied 99 of these 44,000 kg payload trailers.

To operate in the UOR I-LET role, modifications to the Wheeled Tanker tractors were limited. They primarily centred on lowering the fifth wheel height and fitting 14.00 R 20 tyres to replace the standard 16.00 R 20 tyres. When coupled to a Wheeled Tanker tractor, the trailer payload was limited to 19,000 kg, due to the axle and fifth wheel load ratings of the tractor unit.

Post-Afghanistan the six armoured tractor units essentially stood idle. Four were to be converted as part of the current LET project, with the remaining two originally designated to be cannibalised for spare parts. However, following examination by MiVi, under a standalone PDS task the two 'donor' vehicles were instead designated to be refurbished and returned to service as standard unarmoured Wheeled Tanker tractors.

FLET to CAVP and Beyond

By 2009 the British Army's Seddon Atkinson LET replacement programme (Future Light Equipment Transporter (FLET)) had been cancelled for reassessment. Two submissions had been received for the requirement – Oshkosh with a Wheeled Tanker derivative and MAN with a HX Support Vehicle derivative. Oshkosh was selected as preferred bidder prior to can-



Photo: UK MoD

The Oshkosh Wheeled Tanker tractor

shkosh converted a further 77 Wheeled Tanker tractor units into a dual MET/Wheeled Tanker configuration. At the time, MET was designated Light Equipment Transporter (LET).

Oshkosh sub-contracted MiVi of Leyland to carry out the conversion work on the tractor units. Broshuis BV of The Netherlands, the supplier of the in-service trail-

at remote MoD-controlled sites including Mönchengladbach, Germany, by MiVi.

Conversion work per tractor unit was around 150 hours, with conversion work per trailer around 50 hours. Work to fit 11 of the tractors with a Plasan-supplied armour package from MoD storage added around 300 hours of work per vehicle.

The project to convert up to 118 of the 357 in-service Wheeled Tanker tractors into the LET configuration dates back to around 2012, and the UK MoD's desire for a new LET capability dates back even further to at least 2008. Earlier still, during 2004 as an Urgent Operational Requirement (UOR) for Afghanistan, an initial six Wheeled Tanker tractors were

Author

Shaun Connors is a truck and logistics vehicle expert. He has worked as a contributor to Janes and various other publications.

cellation. Later that year, in September the UK MoD announced that Frazer-Nash Consultancy had been appointed to oversee production of the Combined Articulated Vehicle Programme (CAVP) User, System and Service Requirements Documents (URD/SRD). Superseding FLET, CAVP was ultimately expected to call for a common tractor unit in a requirement that in addition to delivering a FLET capability would include a replacement for the General Support Tanker (GST), plus a small number of specialist transporters for the Royal Air Force (RAF). The GST requirement is believed to remain outstanding.

However, in 2013 and with CAVP effectively stalled and the Seddon Atkinson LET having been declared obsolete in 2012, a Wheeled Tanker tractor unit was shipped to the United States as Government Furnished Equipment (GFE) during 2013 and LET-specific modifications were carried out. This work was MoD-funded as a Wheeled Tanker PDS task. The vehicle was returned to the UK later in the year and undertook a short series of confidence trials at the British Army's Combat Service Support Training and Development Unit (CSS TDU), Long Valley. Modifications to the tractor unit, which would later be applied to all 77 follow-on conversions, were based around the rear two axles and their TAK-4 independent suspension. The original 9,000 kg-rated coil sprung units were replaced by an 11,800 kg-rated hydro-pneumatic suspension setup with variable ride height. This modification allows for a maximum king pin load increase from 9,000 kg to 15,000 kg, and a permissible gross combination weight (GCW) increase from 44,000 kg (design rating) to 68,000 kg, at which the vehicle would operate as Special Type General Order (STGO) Category 2, with payloads of up to 44,000 kg.

Other modifications were essentially limited to larger brake actuators, to cope with increased weights, a new hydraulic pump to allow for a trailer-mounted winch to be powered by the tractor unit, and uprated propshafts. Two key MoD requirements for the uprated tractor unit, which were met, were that it has UK Type Approval, and that it retained its Wheeled Tanker tractor capability, and so able to serve in both the Wheeled Tanker and LET roles. A modified tractor unit can switch between roles, with driver input limited to using a single switch to inform the central tyre inflation system (CTIS) of the vehicle role, due to optimum tyre pressures being role-specific.

Photo: Shaun Connors



The Wheeled Tanker tractor is a modified MK23 MTVR with shorter wheelbase and an extended cab.

As an interim LET-type solution, 78 Broshuis trailers were converted by Broshuis during 2012-2013 to Modified Light Equipment Transporter (M-LET). These were then able to operate with a standard Wheeled Tanker tractor, albeit at a reduced 19,000 kg payload. Broshuis' modifications centred on raising the swan neck height by 170 mm. Other work included a full strip-down and re-spray, air, electric, and braking system modifications/upgrades, as well as new ramps. Additionally, a winch is fitted to the swan neck of some trailers for the handling of casualty vehicles. Following upgrade, trailers were returned with a new five-year chassis warranty. Service entry for the M-LET standard Wheeled Tanker tractor combinations occurred during 2012-2013. It is these trailers that are being used under the current LET project, with additional work limited to the addition of two new tie-down points, and the upgrade of existing ones.

Prior to the delivery of the new LET capability, the majority of the UK MoD's 19,000-44,000 kg lifts were performed by civilian contractors, with Oshkosh 1070F HETs available for the tactical movement of these loads.

MTVR/Wheeled Tanker

The Wheeled Tanker tractor unit is a derivative of the Oshkosh Medium Tactical Vehicle Replacement (MTVR). The MTVR was designed to meet a US Marine Corps (USMC) requirement and the type is the

Marines' standard vehicle in its weight class. Between 2001 and 2013 around 11,400 MTVRs were delivered to the USMC. The UK MoD became the first export customer for the MTVR when in March 2003 Oshkosh Truck was awarded the Wheeled Tanker contract.

The Wheeled Tanker tractor is a modified MK23 MTVR with a wheelbase shortened by 330 mm and the cab extended by 660 mm. Automotive changes include the Caterpillar C-12 six-cylinder diesel uprated from 425 hp to 445 hp (317 kW to 332 kW) and upgraded to meet EURO 3 emissions regulations. The 7F/1R Allison HD 4070P automatic transmission of the standard MTVR is replaced by a 6F/1R 'wide ratio' Allison HD 4560P unit.

Valued at approximately GBP 160 million for initial vehicle acquisition and support over 15 years, the Wheeled Tanker requirement called for 218 Close Support Tankers (CSTs) (fuel) with a 20,000-litre capacity; 82 × Tactical Aircraft Refuelers (TARs) with a 15,000-litre capacity, and 48 CSTs (water) with an 18,000-litre capacity, and additionally a contract option for an additional nine CST (water) was exercised. All tanker trailers were supplied by Magyar of France. Wheeled Tanker deliveries began in February 2005 and were completed in November 2006. The contract was extended to March 2023 to enable completion of the LET/Wheeled Tanker conversion and will be extended sole source to Oshkosh out to 2030 for Wheeled Tanker and LET trailer support. ■

OMFV and RCV Programme Updates

Sidney E. Dean

The US Army is currently developing the Next Generation Combat Vehicle (NGCV) family of systems. The goal is to prepare infantry formations for the changing face of manoeuvre warfare.

This goal is to be accomplished by replacing decades-old combat vehicles with more capable modern systems and simultaneously introducing brand new technologies and capabilities. In addition to improved manoeuvre and combat capability, the innovations are intended to enhance soldier survivability.

The overall programme is managed by the Army Futures Command Next Generation Combat Vehicles Cross-Functional Team, or NGCV CFT, based in Warren, Michigan. There are four component programmes within the NGCV purview: the Armored Multi-Purpose Vehicle (AMPF) to replace the M113 armoured personnel carrier; the Mobile Protected Fires (MPF) light tank to support light infantry brigades; the Optionally Manned Fighting Vehicle (OMFV) to replace the M2 BRADLEY Infantry Fighting Vehicle; and the completely new category of the Robotic Combat Vehicle. This article will discuss the status of the latter two component programmes.

The OMFV Programme

The OMFV programme was initiated in Fiscal Year 2018 (FY 2018). The programme aims to develop a successor to the M2 BRADLEY Infantry Fighting Vehicle (IFV) which entered service in 1981. While the BRADLEY has undergone repeated upgrades, the framework has now reached the limits of growth. In order to incorporate future technologies and achieve new capabilities required to retain battlefield superiority, a clean-sheet new design is deemed necessary.

The mission profile mirrors that of the BRADLEY, and includes battlefield infantry transport, fire support, and direct engagement of enemy vehicles. According to the Army, the OMFV is intended to not merely replace the BRADLEY, but to “bring transformative flexibility and lethality capabilities to future battlefield commanders.” The “Optionally Manned” portion of the vehicle designation refers to the required ability to be remotely operated by a dismounted crew. The OMFV is also being designed to oper-



Credit: Rheinmetall

Rheinmetall is basing its OMFV design on the LYNX IFV.



Credit: BAE

BAE is using the RV-301 “Rolling Lab” as a platform to test major components of the firm’s OMFV concept.

ate in tandem with the fully unmanned Robotic Combat Vehicles currently under development.

The Army has identified four specific capabilities required of the new vehicle:

1) Enable command and control at the platoon level and higher by rapidly generating, receiving and passing information to

dismounted elements, other vehicles and command nodes;

2) Provide decisive lethality by detecting, engaging and destroying enemy IFVs beyond range of the enemy’s primary weapon system, while also defeating dismounted infantry. OMFV is further intended to enhance unit-level lethality by contributing

targeting data and situational awareness;

3) Reduce logistical burden through enhanced reliability and on-board diagnostics and prognostics, ease of maintenance, and a simplified supply chain for parts and consumables;

4) Built-in growth margins for easy insertion and integration of future technologies including enhanced armour, vectronics, and the potential for electromagnetic-spectrum weapons. To this end, OMFV is conceived from the beginning as a Modular Open Systems Architecture (MOSA) platform with standardised hardware, software and data interfaces; the MOSA itself is based on Army designed- and owned standards. This will enable the Army to regularly modernise existing vehicles quickly and at reduced expense.

The Five Phases of OMFV

OMFV is being developed through open-source contracts, and is the first major ground combat vehicle being developed using digital engineering. The programme is divided into five phases:

Phase 1) Market Research and Requirement Development (completed early 2020);

Phase 2) Concept Design: The programme is currently in Phase 2. The Army awarded five competing firms contracts for digital concept design in July 2021: American Rheinmetall Vehicles, LLC; BAE Systems Land Armaments L.P.; General Dynamics Land Systems, Inc.; Oshkosh Defense LLC (in partnership with Hanwha Defense); and Point Blank enterprises, Inc. The ongoing Concept Design phase focuses on digital modelling, simulation and analysis (MSA) to inform requirements and support initial design efforts. This approach enables the Army to evaluate designs as they evolve, and test their operational viability and performance potential through modelling and simulations

Phase 3) Detailed Design: Phase 2 will be followed by a full and open competition for Phase 3, which will lead to mature OMFV designs. Other firms beside the five participants of Phase 2 will be eligible to present their independently developed digital designs for Phase 3 consideration. The Army intends to award up to three detailed design phase contracts in the second quarter of FY 2023. Phase 3 will culminate in late FY 2024 with a Comprehensive Design Review (CDR). The CDR will determine whether prototype designs meet baseline requirements and demonstrate technical maturity and manufacturing viability.

Phase 4) Prototype Build and Test: Successful conclusion of the CDR will pave the way for Phase 4 to be conducted 2025 through



Credit: GDLs

GDLs' KATALYST NGEA mounted on a demonstrator vehicle. In addition to managing combat and mobility functions, the KATALYST NGEA also provides capabilities such as computing, sensor fusion and processing, and power management and distribution.



Credit: Hanwha Defense

The Hanwha REDBACK IFV is the starting point for the Oshkosh-led consortium's OMFV concept.



Credit: PBE

The Point Blank Enterprises concept sketch for the OMFV programme

Photo Credit: NGCV CFT



A Project ORIGIN experimental vehicle dispenses smoke during a Soldier Touchpoint at Fort Benning, Georgia, 6 November 2020. In this scenario, the Project ORIGIN vehicle provides cover for an infantry unit.

Photo: U.S. Army / Spc. Carlos Cuevas Fantauzzi



The autonomous system ORIGIN, armed with a JAVELIN ATGM

Photo: U.S. Army / Pvt. Osvaldo Fuentes



The autonomous weapons system ORIGIN manoeuvres through desert terrain. With new data collection capabilities, ORIGIN provides soldiers with terrain descriptions prior to engaging enemy forces.

2027. According to a 1 July 2022 Army announcement, each contractor participating in Phase 4 will build and provide between seven and 11 physical prototypes of their production-model design, plus two ballistic hulls and turrets, armour coupons, and digital engineering data. Prototype vehicles will be tested and evaluated against the Army's OMFV performance specifications. Toward the end of the prototype build and test phase the Army will conduct a Limited User Test (LUT) to address issues which were identified during the acquisition process to date.

Phase 5) Production and Fielding: Presuming a satisfactory outcome of the prototype testing, the Army can subsequently decide to proceed to programme phase 5, production and fielding. A single competitor will receive an LRIP contract in late FY 2027. The initial tranche of OMFVs will undergo rigorous operational testing. The Army expects to equip the first mechanized infantry unit with the OMFV during FY 2029. A full-rate production (FRP) decision is expected in Q2 of FY 2030.

RfP for OMFV Phases 3 and 4

The Army's budget request for 2023 calls for circa USD 590 million in OMFV Research, Development, Test & Evaluation funding. Part of the funding is intended for source selection for Phase 3 and Phase 4 contractors in the Second Quarter of FY 2023. Funding may double to USD 1.2 billion in 2024.

The contract awards the Army plans to grant in the second quarter (Q2) of FY 2023 will simultaneously cover both Phase 3 and Phase 4 of the OMFV programme, with the same vendors automatically being chosen for both segments of the programme. Both phases together will run for 54 months (18 months for Detailed Design, followed by 36 months for Prototype Build and Test).

The final revised Request for Proposals (RfP) for these two phases of the programme was issued on 1 July 2022, with industry responses due by 1 November 2022. During the design and simulation process of Phase 2, the Army was reluctant to impose excessively detailed requirements, but let industry pursue optimal methods to endow the OMFV with nine vital "characteristics." Despite the insights and lessons learned during that process, the requirements included in the latest RfP – while exhibiting a "slightly greater level of detail" – are not "final requirements," said Brig. Gen. Glenn Dean, programme executive officer for ground combat systems. The Army wants to leave room for industry interpretation in order to maximise flexibility and innovation during the continued design process of

Phase 3, he said on the sidelines of the June 2022 Eurosatory exposition in Paris.

The RfP was published on the US government's contracting website on 1 July 2022. While the document has 100 attachments, a large number of attachments remain classified and were not made available to the public. This includes attachments 0008 (vehicle architecture) and 0029 (classified specifications). However, Gen. Dean was able to reveal a few of the Army's highest-level priorities. These include:

- a medium weight (40–50 ton) tracked chassis;
- A two-person vehicle crew plus six dismounts (to ease the transition from the current BRADLEY three-person crew configuration, the OMFV will include a third crew station which can be utilized until sufficient vehicle automation is integrated and proven);
- A medium calibre main gun (minimum 30mm, with a preferred objective of 50mm), possibly augmented by Anti-Tank Guided Missiles (ATGM) or other weapons;
- The ability to perform silent manoeuvre and silent watch operations, which will de facto require a hybrid electric propulsion system. In addition to the operational capabilities profile, the flexibility provided by hybrid propulsion will contribute to reducing the vehicle's logistics footprint and reducing the impact of fuel-supply disruptions, which the Army has identified as a major area of concern.

The RCV Programme

Robotic Combat Vehicles are intended as armed escorts for manned combat vehicles and are to be incorporated into infantry and armoured brigade combat teams (manned–unmanned teaming or MUM-T). Missions include armed over watch, scouting for enemy forces, ambush detection, obstacle breaching and flank protection. RCVs will be remotely controlled via radio link from within the formation's manned vehicles; the Army is also considering semi-autonomous unmanned vehicles if AI maturity permits their safe operation.

The vehicles will feature modular, open architecture designs and will be able to incorporate interchangeable mission equipment modules to meet various operational requirements. Attributes expected across all classes include Assured Position, Navigation and Timing (A-PNT) capable of defeating enemy jamming; tethered unmanned aerial systems (TeUAS) for surveillance and targeting; counter UAS (CUAS) systems; smoke generation (visual and multispec-



Photo: US Army

T Project ORIGIN vehicle proved capable of engaging line-of-sight and non-line-of-sight targets.



Photo: US Army

Army Green Berets conducted two weeks of hands-on experimentation with Project ORIGIN Unmanned Systems at Dugway Proving Ground, Utah, to provide more understanding of what is needed to mature unmanned systems for the Army's Operating Force.



Photo Credit: Bruce Huffman/Michigan National Guard

The Robotic Combat Vehicle-Light (RCV-L) experimental prototype is a small, lightweight hybrid-electric unmanned ground combat vehicle that can be transported easily by military aircraft.

tral); CBRNE (chemical, biological, radiological, nuclear, and explosive) stand-off detection; and electronic warfare (EW) capabilities.

The Army plans to procure RCVs in three different size categories.

Light vehicles (RCV-L) are to weigh no more than 10 tons and be air transportable by rotary lift aircraft. Dimensions (LxWxH) are not to exceed 569x224x239 cm. The RCV-L is intended to be “expendable” but should be robust enough to survive a first encounter with dismounted forces and relay the situational picture to operators. The RCV is intended to operate up to two km ahead of the controlling vehicle, both to ensure a secure radio link and to keep the robot within supporting range of the controlling vehicle’s direct fire weapon. The RCV-L will carry its own stabilized primary weapon with a 360° arc of fire, capable of defeating infantry and unarmoured vehicles; the ability to stow and fire one ATGM in order to degrade a heavy armoured vehicle or breach an obstacle; the ability for future integration of a weapon station capable of defeating infantry and of mounting two ATGMs. Despite the armament, the RCV-L is expected to be deployed primarily in the reconnaissance role, using sensors to provide situational awareness and targeting data for other forces.

Medium vehicles (RCV-M) will fall between 10 and 20 tons and require a C-130 for airlift. Dimensions should not exceed 584x272x239 cm. These robots will be designed for greater durability and lethality, with the ability to defeat light to medium-armoured vehicles. A medium calibre main weapon system will be required to balance lethality and mobility. The RCV-M is expected to qualify for direct fire support missions.

Photo: US Army



A Robotic Combat Vehicle-Medium fires a round at a target during the vehicle’s live fire testing at Fort Dix, New Jersey, 30 June 2021.

The heavy RCV-H will weigh in at 20 to 30 tons and maximum dimensions of 889x366x361 cm. Two vehicles can be transported per C-17. The RCV-H will mount direct fire weapons and be capable of defeating all known enemy armoured vehicle. The weapon system is categorized as “durable,” which requires it to have comparable survivability to manned armoured vehicles. As presented by Maj. Cory Wallace, RCV requirements lead officer, in 2021, “the RCV heavy is a robotic tank. So just as an M1A1 — or M1A2 — can deliver decisive lethality via onboard means, so too can the RCV heavy.”

RCV Progress to Date

The RCV-H concept began testing in 2019 using remote-controlled M113 armoured

personnel carriers as surrogates, teaming with manned BRADLEY IFVs. The evaluation culminated in July–August 2020 during a month-long exercise at Fort Carson, Colorado. Communications interface and vehicle remote control were found satisfactory. The testing also verified the basic tactical advantage of deploying RCVs as scouts and force protection assets in advance of manned units. Nonetheless, since then the Army has focussed its efforts on the Light and Medium variants. According to RCV product manager Lt. Col. Christopher Orłowski, RCV-H is now lagging behind the other two weight classes by a significant margin. At this time the future of the heavy robotic combat vehicle is unclear.

Since 2020 the Army has been integrating the Project ORIGIN vehicle into platoon level tactical exercise and training scenarios alongside manned vehicles or dismounted infantry; this includes a month-long Soldier Operational Experiment (SOE) conducted in November 2020 at Fort Benning, Georgia. This 8x8 wheeled unmanned ground vehicle (UGV) can be fitted with a broad array of lethal and non-lethal modular mission packages (MMP). The experimentation has provided significant amount of insight into deployment concepts, the challenges inherent in battlefield manned–unmanned teaming, and the overall operational utility of RCVs.

However, the Project ORIGIN UGV is too generic to investigate the full potential of a future RCV-L or RCV-M. In January 2020 the Army awarded QinetiQ North America a contract for four RCV-L surrogates, and Textron a contract for four RCV-M surrogates. QinetiQ, in partnership with Pratt & Miller, chose to submit a derivative of the

Photo: Textron



Textron has provided the RIPSAN M5 for evaluation of the RCV-M concept. Shown here with a 30mm gun turret.

Expeditionary Modular Autonomous Vehicle (EMAV), while Textron, in cooperation with Howell & Howell and FLIR, submitted the M5-E variant of its Ripsaw unmanned ground vehicle.

The vehicles, which were delivered from late 2020 through mid-2021, meet the size and overall performance parameters of the respective RCV classes, and can mount the various MMPs under consideration. However, while purpose built for the evaluation phase of the RCV programme, they are not the actual competitors for production contracts. The results of surrogate testing will guide the Army in formulating precise technical and performance requirements of future production RCVs. The surrogates will also be more optimal platforms for developing tactics, techniques and procedures to realistically enhance combat units' lethality through MUM-T.

Following a year of software integration, training of operators, and general evaluation (including live-fire testing), the surrogates are scheduled to be put through their paces in an extended SOE to be conducted between June and September 2022 at Fort Hood, Texas. The SOE at Fort Hood will see the first company-level deployment of RCVs, with all four Light vehicles operating as a unit, and four RCV-Ms operating as a second complete unit. The RCVs will deploy in both attack and defend roles.

Following a year of software integration, training of operators, and general evaluation (including live-fire testing), the surrogates entered an extended SOE in late July 2022. The evaluation is being conducted at Fort Hood, Texas and will continue until late summer. The SOE at Fort Hood involves the first company-level deployment of RCVs, with all four Light vehicles operating as a unit, and four RCV-Ms operating as a second complete unit. The vehicles are being deployed in both attack and defend roles. Onboard systems being deployed include the tethered UAS, a counter-UAS jammer, a modular smoke obscuration module, a Common Remote Operated Weapon System (with crew-served weapons up to 50-caliber, and a JAVELIN ATGM), and an autonomous drive function. Performance over a broad spectrum of realistic battlefield terrain, as well as the vehicles' ability to identify and avoid obstacles and to fire weapons while on the move, are major aspects being evaluated. Additional SOEs are planned over the next 36 months. "Soldier feedback is the foundation for every single requirement we're writing" in order to ensure that engineers design systems that are truly useful in the field, said Maj. Wallace.



Photo: Textron

The RCV-M surrogate overcoming a roadblock.

Testing and Selection

RCV-L now has the highest priority within the robotic combat vehicle programme. In February 2022 it was categorized as a rapid prototyping project, with the intent to speed development of an operational system. According to a briefing conducted by Lt. Col. Orłowski in April 2022, the RFP for RCV-L will be published in the September–October 2022 timeframe, leading to an open competition for the engineering and manufacturing development (EMD) phase. Up to five firms will be selected for EMD contracts in Q4 of FY 2023. Each firm will submit two full-system prototypes to the Army for testing, which will continue through Q3 of FY 2024. This will lead to downselect of a single contractor, who will be required to submit additional prototypes for further in-depth testing through 2026. Prototype evaluation and testing is expected to wrap up in Q3 of FY 2026, with a decision to progress to serial production to be made between Q4 of FY 2026 and Q2 of FY 2027. Army budget documents for FY 2023 show that approximately US\$700M are being requested for RCV-L over the next five years. This figure includes funding for continued surrogate testing as well as software development.

A decision regarding progression to the EMD phase of the RCV-M programme is planned for FY 2024. Lt. Col. Orłowski stressed in April that the RCV-M prototyping and fielding timeline is still conceptual and subject to Army senior leadership approval.

Meanwhile, evaluation of the current RCV-L and RCV-M surrogates is scheduled to continue through the end of FY 2025. Participating soldiers' feedback will inform the design of the operational prototypes, and identify components and capabilities that should be included. Major aspects of the surrogate evaluation will focus on vehi-

cle autonomy software, cybersecurity, and spectrum resiliency.

Manned–Unmanned Teaming – Wave of the Future

It is no accident that OMFV and RCV are being developed simultaneously. Manned–Unmanned Teaming is slated to assume an important role in future Army combat operations, both to reduce exposure of soldiers and to extend the operational range and situational awareness of ground formations. "If you could extend the battlefield up to two kilometres with a robot, then that means that you can make decisions before your enemy comes," said Maj. Gen. Ross Coffman, director of the Next Generation Combat Vehicle Cross Functional Team at the US Army Futures Command (AFC), in June 2021. Coffman, who was selected in June 2022 for promotion and appointment as deputy AFC commander, added that RCVs could be used to lure an advancing opponent in while manned units withdraw. "Now you can pair these robots with unmanned aerial vehicles and they'll continue to report, continue to engage and make the enemy deploy faster. We can then [unleash] mass-effects on their main effort," he stated.

Depending on the requisite firepower up front, remotely controlled OMFVs could add their firepower to the robotic front line. The ongoing and imminent test and evaluation cycles for both OMFV and RCVs will determine whether unmanned systems are best suited to relieving manned vehicles from the most dangerous battlefield roles, or whether they can enhance total force lethality by assuming new roles. While robotic combat vehicles will never replace the human soldier as the core element of ground warfare, MUM-T will make its mark on tactics and doctrine over the coming decade and more. ■

Sensor to Shooter Chains Turn into Kill Webs

Tamir Eshel

Western military powers rely on sophisticated and precise weapons to deter and defeat asymmetric and near-peer opponents. To be effective, such weapons are matched with accurate information regarding their targets, such as location and status.

When time-critical targets are involved, this information needs to be provided rapidly, otherwise, the target may relocate. The process defined as a 'Sensor to Shooter' (STS) cycle represents the process of carrying out an attack. It relates to intelligence, surveillance, reconnaissance, and target acquisition (ISTAR) assets, information processing, decision-making, and the weapon systems involved. The ability to rapidly progress through the various stages of this process is critical for modern armies, from the tactical to the strategic levels.

Photo: Rafael



Rafael's FIRE WEAVER is a sensor-to-shooter system intended for battalion-sized tactical formations.

From Kill Chain to Kill Web

The STS cycle has many synonyms, among the most common is the 'Kill Chain,' defining the process from the appearance of a target, through planning and authorisation, to target engagement. Traditionally, the kill chain reflects a linear set of procedures associated with the individual elements involved in the process. However, maintaining discrete kill chains for each target are not always suited to urgent requests or taking advantage of brief opportunities. Modern armies have sought to accelerate this process through streamlined data sharing, faster data-links, automated processes, and parallel tasking, resulting in a 'kill web' with the ultimate goal to enable strikes within seconds rather than minutes or hours. In a military relying on precision effects, sensors are as crucial as the effectors. Frequently, improving sensors contributes to increasing strike efficiency more than upgrading the weapons, as improving sensors and information processing provides more engagement opportunities and elevates the probability of successful engagements. Such improvements may include increasing the number or variety of sensors feeding the 'sensor to shooter' system and expanding bandwidth to increase the speed and depth of the infor-

mation transfer and the quality of information delivered. Creating a 'sensor web' of multiple different sensors enables the fusion of several feeds, improving the probability of detecting concealed targets and providing more accurate information for the shooters.

Sensors are often co-located with a weapon, creating close-knit sensor-to-shooter systems, but in other scenarios, sensors, command and control (C2), and shooters are distributed. As sensor data is transferred over wireless networks, bandwidth limitations, electronic attacks, and interference can cause congestion and delay information flow and processing. Satellite links are particularly vulnerable to these disruptions. Modern mesh networks have inherent resilience to withstand such challenges and are often used in contemporary sensor networks. In cases where weapon systems are relatively close to each other, such networks can provide a 'tactical cloud' allowing communication even in the face of jamming.

Drone maker AeroVironment has introduced an example of a close-knit STS system comprising a surveillance drone - PUMA 3 AE coupled with the SWITCHBLADE 300 loitering munition. The operator can use the SWITCHBLADE 300 STS Kit to monitor both systems using the same display, allowing them to see the PUMA 3 AE's sensor view before and after the attack, alongside the feed from the loitering munition's camera as it closes on the target. The sensors and data-links of the two systems are designed to synchronise with the map view displayed on the same control unit. This process simplifies and accelerates responses to targets of opportunity encountered on surveillance missions. Both sides in the Russia-Ukraine War have employed this cross-UAV hunter-killer teaming.

Streamlining the Process

Streamlining processes across echelons, domains, and coalition partners is much more complex. A case in point is the

artillery counterfire mission, as seen in Ukraine. Artillery fires follow structured, detailed planning and fire direction processes before the first round is fired. But executing a counterfire against enemy artillery targets must be shorter, as the target are often 'short-lived,' especially when mobile rocket launchers and self-propelled artillery are involved. Such missions rely on various sensors such as acoustic sensors, radars, to detect enemy fires, and use computers to calculate enemy fire trajectories and extrapolate the hostile fire position. This process therefore needs to be conducted rapidly before the enemy can leave their fire position. In the counterfire STS cycle, both sensor and shooter are operated by the artillery, often at the division or corps level. They share networks, procedures, and message formats to rapidly process the information and execute a counterfire mission.

At very long ranges, responding to hostile fires requires more sensors to provide sufficient coverage. For instance, responding to ballistic missiles with ranges of hundreds of kilometres would require targeting information based on higher echelon sensors and intelligence sources that may not be available to the shooters. The US Army plans to integrate new communications satellites deployed in low-earth orbit (LEO) called the Tactical Space Layer (TSL), along with the Tactical Intelligence Targeting Access Node (TITAN) ground station to support the requirement for shortening the sensor-to-shooter cycle at long ranges.

Another consideration is the connectivity between sensors and information systems, which can be lengthy and complex. When operating at the tactical level, the sharing of a single communications layer shared between sensors and shooters can simplify connectivity, while automation can be used to decrease the cognitive burden on operators.

Although accelerating the STS cycle requires improving many elements, it often consists of flattening hierarchies and clearing barriers in extant processes. Another means of accelerating the process is machine-to-machine connectivity, which can be most readily achieved at lower levels. Such solutions are more challenging to implement at higher echelons, particularly in joint and multinational coalition operations, where connectivity among diverse information systems and data-sharing standards becomes necessary. Sometimes, bringing two officers together in a single room may solve long delays better than automation. Other so-



Photo: US Army

US Army rendering of a kill web

lutions involve the introduction of information translators to streamline connectivity between different computing systems. Once information systems can talk to each other, additional enhancements can be introduced, such as using machine learning and artificial intelligence to process large volumes of data.

Connecting All sensors and Shooters

In a modern kill web, sensors can upload their feed to a tactical cloud, forming a network shared by many sensors and users instead of linking a specific sensor to a particular user. To minimize upload bandwidth requirements, feeds can be pre-processed with artificial intelligence and machine learning to perform automatic target recognition (ATR) and data mining. Uploading these events with their time-critical data is prioritized, along with other feeds that could be meaningful for some users. Further processing can be done in the cloud, including measurements, situational assessment, and correlation with other sensors, to generate additional information that may be needed in the decision-making process.

The Joint All Domain Command & Control (JADC2) pursued by the US Department of Defense (DoD) is the manifestation of the kill web concept, aimed at increasing interoperability and decision-making speed. Although such a network is promising in theory, its implementation is complex, particularly in the land domain, and its continuous operation in a contested environment cannot be guaranteed. Therefore, users should maintain the capability to deal with situations where a part of JADC2 is denied or degraded, and forces are required to operate in an isolated fashion.

The US Army has been testing some of the JADC2 aspects in the annual multi-dimensional 'Project Convergence' (PC) exercises, connecting systems and capabilities from the Army, Air Force, Navy, Marine Corps, and Space Force. Last year's exercise (PC21) combined multiple Intelligence, Surveillance, and Reconnaissance (ISR) and weapons platforms into the Army's kill web mesh network to produce a detailed real-time common operating picture (COP). This endeavour relied on 110 new technologies and concepts.

At PC21, the Army employed its first of a planned five combat cloud servers for the Multi-Domain Task Force (MTDF) operational framework. Each combat cloud server is capable of processing a complete sensor-to-shooter system via satellite link, and one server is planned for each of the Army's five MDTFs. Each MDTF is due to be respectively based in the continental US, Europe, the Pacific, and the Arctic, while the fifth will be designated as the global MDTF – an air-mobile unit ready to deploy a kill web anywhere in the world within 24 hours. Each MDTF cloud server runs four AI programs to automate the kill web, known as RAINMAKER, PRO-METHEUS, FIRESTORM, and SHOT.

Four Knights of the Kill Web

At PC21, RAINMAKER connected 15 sensors and 19 weapon systems to a combat cloud via satellite link. RAINMAKER translates data from different sources, each having its own 'language.' At PC21, RAINMAKER also faced simulated challenges of electronic jamming, and deception of position, navigation, and timing (PNT) data by opposition forces as part of the exercise. To overcome those challenges, RAINMAKER implemented new jam-resistant waveforms over the radio

frequency (RF) links and sought open communications channels to reconfigure the network to maintain sensor feeds.

The task of PROMETHEUS was to seek threats and targets in the sensor feed provided by RAINMAKER from the ISR platforms. Once targets were found, they were handed to the 'Fires Synchronization To Optimize Responses in Multi-domain operations' (FIRESTORM) program, whose job was to match the best 'shooter' to the most appropriate target, based on the locations and status of each of the shooters connected to the system. For each target, FIRESTORM presented dozens of 'sensor-target-weapon' firing solutions to the battlefield commander. Once a selection is made, it is sent to the Synchronized High Optempo Targeting (SHOT) program for execution. As the selected weapons receive the order to fire or launch within seconds, all other shooters associated with the task were released for different missions. At that point, PROMETHEUS takes over to perform battle damage assessment. The whole process involving this complex four-programme sequence takes only a few seconds.

The US Army's first MDTF was established at Lewis-McChord in Washington State in 2017, while the second was established at the Clay Kaserne base in Wiesbaden, Germany in September 2021. The Army plans to activate its third MTDF at Schofield Barracks, Hawaii in 2023.

New STS Capabilities

Another sensor-to-shooter concept brewing in Israel is the development of 'Storm Clouds', involving the integration of new systems as part of a buildup of new units and capabilities. The 144th squadron activated at the Hatzor air force base on 3 August 2022 is a component of this concept. The new unit will operate Aeronautics' ORBITER 4 UAV, providing the aerial ISR layer of the Israeli Defense Forces' (IDF) 'Storm Clouds' program. This ambitious system of systems is part of a comprehensive, automated wide-area surveillance, target acquisition, and automated intelligence processing system intended to empower small independent forces in operations. The networking of sensors, battle management systems, weapons, and

data processing systems allows them to become part of distributed 'sensor-to-shooter' systems. Rafael's FIRE WEAVER is a sensor-to-shooter system intended for battalion-sized tactical formations. Rafael has recently introduced a sensor-to-shooter system for SPIKE NLOS, called SPIKE NLOS Mission Taskforce (SPIKE NMT). This system integrates the camera sensors on ORBITER-4 UAVs and Rafael BNET software-defined radio, with the FIRE WEAVER system. The system employs the SPIKE NLOS 6th Generation missile, which can be mounted on land platforms, giving a range of 32 km, or helicopter, giving a range of 50 km.

Sensor-to-shooter systems provide a promising means for militaries to keep pace on increasingly complex battlefields. Yet, as the experiences of many startup companies show, the key to successful implementation that wins over users is to take small, simple steps. Navigating vast and ultra-complex systems of systems may be simple for machines, but on the battlefield the human operator must come first. ■

US Army Future Vertical Lift: A Status Report

Sidney E. Dean

The US Army's Future Vertical Lift (FVL) programme aims to replace the current tactical vertical lift fleet with state-of-the-art systems endowed with enhanced manoeuvrability, range, speed, payload, survivability, reliability, and reduced logistical footprint.

Increased range and speed are intended to enhance survivability and permit missions to begin from beyond the reach of enemy long-range weapons, and to overcome the "tyranny of distance" which strains current vertical lift aircraft's capabilities in far-flung operating zones.

The aspirational FVL family consists of two aircraft classes: the medium-weight Future Long-Range Assault Aircraft (FLRAA) and the Future Attack Reconnaissance Aircraft (FARA). According to Congressional testimony by Army Chief of Staff Gen. James McConville on 5 May 2022, the service continues to fund both FLRAA and FARA, and is "on track to have both systems begin fielding by Fiscal Year 2030."

FLRAA

FLRAA is conceived as a transport utility platform optimised for assault transport of airmobile forces, combat search and rescue, casualty evacuation, special operations missions, and for general support missions. It will ultimately succeed the Army's UH-60 BLACK HAWK and the US Marine Corps' H-1 HUEY helicopters. Two teams were selected in March 2020 to participate in the competitive demonstration and risk reduction (CD&RR) phase of the programme. In March 2021, they received awards to continue into CD&RR phase 2, which focusses on the risk reduction aspect. Both teams' dem-

onstrator aircraft feature notable performance advantages over the currently deployed helicopters, including circa twice the unrefueled operational range.

The Bell Helicopter Textron V-280 VALOR prototype is a clean-sheet design incorporating third-generation tiltrotor technology. The combination of carbon-fibre construction and triple-redundant fly-by-wire systems reduces aircraft weight and lightens aircrew workload. The aircraft achieved first flight in December 2017. Flight evaluation ended in June 2021 after more than 160 individual test flights, during which top speeds of 280 knots were reached. Bell stated that all goals of the demonstration phase had been achieved.

The Boeing–Sikorsky SB-1 DEFIANT X is a compound helicopter which utilises twin coaxial rotors for lift, and a rear-mounted pusher propellor to significantly increase speed over conventional helicopter designs. It is a variant of the original SB-1 demonstrator which first flew in 2019. Unlike the original, the DEFIANT X was specifically configured for the FLRAA competition. It achieved first flight in January 2022, reaching 236 knots. It has subsequently flown at nearly 250 knots. Details of the Army's Request for Proposals for a final design, which was presented to industry in July 2021, were not made public. Gen. McConville's 5 May 2022 testimony included the assurance that the Army is "scheduled to down select FLRAA to a single vendor in the coming months." Down-select to a single vendor could be delayed to "perhaps early first quarter [FY]23," said Douglas Bush, US Army Assistant Secretary for acquisition, logistics and technology, during congressional testimony in late July 2022. The engineering and manufacturing development (EMD) phase is expected to begin in October 2023. Barring delays, the critical design review would follow in early 2025. The first prototype would be due in mid-2025, with an additional five prototypes to be delivered through summer of 2026.

FARA

FARA will assume the role of the retired OH-58 KIOWA SCOUT reconnaissance helicopter. Additionally, the Army plans to replace approximately half of the AH-64 APACHE attack helicopter fleet (primarily the older "D" models) with FARA units. In addition to directly executing armed reconnaissance and strike missions, FARA will control unmanned reconnaissance and strike assets, and escort the FLRAA on aerial assault missions.

The FARA programme was initiated in April 2019 with design awards to five vendors. The Army chose to skip the CD&RR phase, and in March 2020 directly downselected to two competitors – Bell and a Lockheed Martin-Sikorsky team to design and develop operational prototypes. As required by the Army, both teams are using a Modular Open Systems Approach (MOSA) which will simplify maintenance and mission system upgrades during the aircraft's operational life. Both aircraft display a compact design optimised for operations in tight environs including between buildings in urban settings. Both designs feature lateral weapons bays to permit internal



Photo: US Army

The Bell V-280 technology demonstrator



Photo: Lockheed Martin

Concept image of the Sikorsky DEFIANT X FLRAA design



Photo: Bell Helicopter

Concept art of the INVICTUS 360 in action



The competitive prototype of the Lockheed Martin-Sikorsky RAIDER X nearing completion



Concept image of the RAIDER X providing armed escort for a DEFIANT X air assault mission



Concept image of a combined arms operation including the INVICTUS 360 and the V-280 VALOR

carriage of air-to-ground weapons to optimise aerodynamics.

The Bell 360 INVICTUS design utilises a single high-performance four-bladed main rotor system and an open tail rotor (originally Bell planned to use a ducted tail rotor but switched to the more conventional design in 2021). Lift-sharing wings are designed to assume 50% of the lift effort once an airspeed of 180 knots is achieved. The operational prototype is between 80 and 90% complete.

The Lockheed Martin-Sikorsky designed RAIDER X is the team's competitive prototype for the FARA programme. It takes the same basic structural approach as Sikorsky's FLRAA entry, with twin coaxial rotors and a rear-mounted pusher propeller. The firm presents this commonality as an asset which would simplify logistics and ease training, both for aircrews and maintenance personnel.

On 7 July 2022, Sikorsky announced that the prototype is 90% complete. To date, the team continues to use the smaller RAIDER 97 (or S-97) as the technology demonstrator for the programme. These flight tests garner operationally relevant data points on vital aspects such as aerodynamics and manoeuvrability and continue to inform the ongoing RAIDER X design work, Sikorsky's FARA programme chief engineer Pete Germanowski said July 2022. This is shortening the design phase by a year, he added.

The Army requires both teams to utilise the government-designed Improved Turbine Engine Programme (ITEP) turboshaft engine, which is being produced by General Electric as the GE T901-900. Testing delays, attributed in part to the Covid-19 pandemic, have pushed planned delivery of the engine to the design teams back to November 2022. Installing and ground-testing the engines on the operational prototypes is expected to take a year, which will delay major milestones of the FARA programme by at least that long.

The Request for Proposals for the Engineering and Manufacturing Development (EMD) phase has been moved up to the second quarter of FY 2023. The competitive flight test programme is now expected to begin during the first quarter of FY 2024 and run through early FY 2025. That programme phase will be followed by downselect to a single vendor who will receive the EMD contract in FY 2025. The weapon system capability design review for that vendor has advanced to the fourth quarter of FY 2026.

UK Allied Collaboration

Future exports to allied and partner nations have always been a foregone conclusion regarding FVL, especially given the large number of nations using the BLACK HAWK helicopters which FLRAA will replace. Going one step further, on 14 February 2022 the US and the UK signed a formal agreement to share technical information on the FVL programme. The FVL Co-operative Programme Feasibility Assessment agreement is intended to ensure full interoperability and integration of the two nations' future rotary aircraft systems, according to a US Army statement. It will assess future collaboration opportunities for manned rotary aircraft development, testing, production and sustainment, and promote such cooperation. Additionally, the two nations plan to assess collaboration opportunities with regard to unmanned aircraft, air-launched effectors, and the implementation of open architecture systems. A similar agreement was signed with the Netherlands in July 2022. "We've seen the benefits for interoperability among our forces, especially in aviation," said Douglas Bush. "By working closely on our future efforts, we garner the greatest possible strength for the long-term advance of our mutual interest. The allies will also cooperate on developing future concepts of lower-tier air domain operations. "Today's agreement formalises our cooperation to help determine the future direction of aviation in competition and conflict," said Maj. Gen. James Bowder, Director



Photo: US Army

Maj. Gen. Walter Rugen, the US Army Future Command's Future Vertical Lift Cross-Functional Team director, and Maj.-Gen. James Bowder, Director of Futures, UK Army Command, sign the FVL Co-operative Program Feasibility Assessment agreement on 14 February 2022 in Washington.

of Futures, UK Army Command, who signed on behalf of the United Kingdom.

Mixed Force

While the Army plans to equip the first operational units with both the FLRAA and the FARA in 2030, it will take decades to complete the transition from legacy systems. Regarding FARA, a complete transition is not even planned. As Lt. Gen. James Richardson, head of the Army Futures Command, told the Senate Armed Services Committee in May 2022, FARA is considered more of a

scout helicopter which will largely "complement" the APACHE.

In fact, the service continues to upgrade the current UH-60 and AH-64 families, extending their service well into the mid-century. Until the last legacy systems retire, the force will have a mix of units which can be deployed according to the operational requirements. This, and the continued acquisition of sophisticated tactical unmanned aircraft, will contribute to a more efficient management of the FVL units, reducing physical stress on the airframes and extending operational life. ■



Photo: General Electric

The ITEP engine designed by the Army and manufactured by GE will be installed on FARA and will also be retrofitted onto the AH-64, as demonstrated here during a fitting test.

The Search for Game-Changers in Ukraine

Mark Cazalet

(This article was originally published on 26/08/2022 in ESD's sister magazine, Europäische Sicherheit & Technik.)

Since Russia began their invasion on 24 February 2022, there has been a continued tendency on social media and in the press to hype up many Western weapons supplied to Ukraine, often after seeing limited footage of their employment in narrow tactical scenarios. This has often resulted in the fetishisation or even canonisation of weapon systems in the public sphere – see 'Saint JAVELIN', 'Saint NLAW', 'Saint Stinger', along with songs honouring the BAYRAKTAR TB2 UAV and HIMARS rocket artillery system. However, despite the undeniable effectiveness of most of these systems in their roles, much of the initial hype around them as battlefield game-changers has gradually dissipated as the war failed to end, and the public imagination's search for the next wunderwaffe continued.

The reality, as usual is much more complex and nuanced than it typically appears online. In part this hype is generated by a tendency toward myopic focus on individual weapon systems and small-scale tactical victories. Considerably less attention has been paid to combinations of different capabilities, operational conditions, and the significance of different tactical victories within the wider context of the war. This article examines some of the Western systems delivered to Ukraine, and why many observers' expectations have failed to align with reality.

The wunderwaffe that weren't

The BAYRAKTAR TB2 was heralded as a game-changer in the opening weeks of the war, when there was ample footage of UAV strikes on Russian motorised and mechanised columns in transit. These initial glimpses seemed to demonstrate that the UAV could be just as effective in Ukraine as it was in the 2020 Nagorno-Karabakh conflict. However, by the fourth week the quantity of strikes had fallen dramatically, and by the fifth week (24 March) BAYRAKTAR TB2 strikes had dropped to zero, where they remained until Ukraine carried out a series of attacks on Snake Island in early May using both manned aircraft and the TB2, and then again in early July. Even without the slow



The BAYRAKTAR TB2 strike UAV performed relatively well in the opening few weeks of the war, however the quantity of strikes dropped rapidly at the end of the first month as these platforms were downed by aircraft and ground-based air defences.

trickle of photographs showing downed TB2s emerging in the following weeks and months, the rapid drop in reported strikes in the fifth week was a strong indicator that the majority of TB2s had been downed, most likely by a combination of Russian air defences and Russian aircraft, with very few estimated to remain at that point in time. This in turn led to Ukraine becoming more conservative with the use of their remaining TB2s. This assessment has been largely borne out by evidence gathered over several weeks spent in Ukraine by RUSI's Dr Jack Watling, during which time Watling interviewed many serving members of the Ukrainian armed forces. Watling stated in the 'This Means War' podcast released on 30 June that "There are a lot of capabilities, like UAVs of all classes that are just not surviving. The lifespan of a Ukrainian UAV is maybe a week, at best."

Likewise, the arrival of HIMARS was met with considerable hype, and the system quickly proved itself to be effective at striking distant and operationally-vital targets such as command posts and ammunition caches. Yet more than two months after its initial employment, the tempo of GMLRS strikes on critical targets appears to be gradually slowing down as the Russians adapt.

Partially, this may be down to fire missions having caught up to the intelligence cycle – many known targets have already been hit and more intelligence-gathering work and planning will need to be done to find their replacements. It is a little early to make a general assessment, however, there are already some indications that the Russians have begun to find ways of decreasing HIMARS' effectiveness.

One possible indicator of Russia's adaptation has been the number of successful strikes on Kherson's Antonivskiy Bridge, a critical piece of infrastructure in Russian hands providing them with access across the Dnipro river. In the aftermath of initial GMLRS strikes on the bridge on 19 and 27 July 2022, the bridge appeared to have suffered meaningful damage, with approximately five holes shown in footage after the 19 July strikes, and nine or ten holes evident after the 27 July strikes. Russian forces then made efforts to repair the bridge in order to maintain their primary supply line into Kherson, resulting in Ukraine carrying out further strikes on 8 August. However, this time the damage seemed far more superficial, with approximately four smaller holes in the bridge, along with damage to Russian construction equipment.

It would seem the Ukrainian forces also considered the damage insufficient, given that they targeted the bridge with another round of strikes on 14 August. In video footage of the attack, three explosions from what were presumably GMLRS impacts were evident, along with equipment on the bridge burning at the start of the video, suggesting at least four successful impacts on the bridge. While the short clip almost certainly does not tell the entire story, it is sadly one of the only pieces of evidence of the incident publicly available for analysis.

The footage appeared to indicate at least one interception of a GMLRS rocket by Russian air defences, though it is difficult to evaluate success from this footage alone. Aside from the limitations imposed by low-resolution, low-framerate cameras, attempting to count the telltale twin-fireballs of two warhead detonations is not the most reliable method for judging successful interceptions. This is because interceptions do not always destroy the warhead of the rocket. An interception may instead cause damage to the rocket's stabilisers, control surfaces, or guidance system, thus changing its trajectory and resulting in the rocket failing to reach its target, typically falling elsewhere. Such interceptions are less tidy and less easy to spot than those resulting in warhead destruction, but they usually still get the job done. However, to an outside observer, the missile may appear to have survived intact, complicating the task of assessing the interception's success or failure. This effect can also be exploited by the opponent for propaganda value, to claim more successful strikes on target than there actually were. In the absence of hard visual evidence of interceptions, the next-best method for determining their likelihood is assessing the aftermath of strikes. Here, the lower quantity of recorded impacts on the bridge in August compared to July is perhaps the most telling sign that not all GMLRS rockets launched are reaching their targets. Given that there has been no evidence to suggest that Ukraine has suddenly decided to opt for launching smaller salvos, nor that Ukraine's GMLRS rockets have been experiencing an unusually-high failure rate, the most likely explanation is that some of them are being intercepted. This seems to be supported by subsequent footage of Russian forces continuing to use the bridge after a reported further round of strikes on 25 August. However, a series of several strikes carried out on 26 August seemed to have damaged the bridge sufficiently to at least temporarily prevent its use. Although little information is available on the nature of the munitions used in these strikes, the close grouping of holes would suggest the bulk of hits were



Photo: John Hamilton/White Sands Missile Range Public Affairs

An ATACMS family missile undergoes a live fire test at the White Sands Missile Range on 14 December 2021. Although ATACMS possess greater range and payload than GMLRS, they are less suited for use in heavily-defended airspace.

probably caused by GMLRS, possibly supplemented by other munitions.

The Search Continues

By early August, two further weapons began to receive attract speculation as the next potential game-changers for Ukraine. The first of these was the AGM-88 High-Speed Anti-Radiation (HARM) missile, following US Undersecretary of Defense for Policy Dr Colin Kahl's 8 August announcement that the US had provided Ukraine with air-launched anti-radiation missiles. The Pentagon later confirmed that these were AGM-88 HARM, and that they had already been integrated on Ukrainian aircraft and employed by Ukrainian forces. This confirmed speculation dating from early August that Ukraine had begun to use HARMs, following images of a HARM wreckage in Ukraine surfacing on social media.

The second was the AGM-140 Army Tactical Missile System (ATACMS), which emerged as an early suspect in the 9 August strikes on Saky airbase in Crimea, a charge which was denied by a Pentagon spokesperson during a 12 August briefing, with the spokesperson stating that the US has not provided Ukraine with ATACMS, nor any weapon capable of reaching Crimea. Ukraine has requested ATACMS, and although the US' primary reason for not providing ATACMS was reported to be its potential for Ukraine to launch attacks on Russia proper, there are also precious few reasons to believe that the missile would become a real game-changer for Ukraine.

For starters, ATACMS would broadly play to the strengths of Russia's air defence systems. Compared to the smaller and shorter-range M31 series GMLRS rockets Ukraine has been using so far with its HIMARS systems, ATACMS must necessarily fly higher as a function of its greater range and ballistic trajectory. On top of this, the missile is much

larger than a GMLRS rocket and has a larger radar cross-section (RCS), meaning that the range at which Russian radars will be able to detect it, and hence respond will be greater. Together these factors would increase Russian Air Defenders' window of time to react and would expose the missile to possible interception by Russia's longer-range air defences, such as the Buk, S-350, S-300P, S-300V, and S-400 families.

Secondly, by virtue of its size the ATACMS necessarily has much weaker saturation potential than the GMLRS, with battery of four HIMARS capable of launching either four ATACMS, or 24 GMLRS. For the Russian air defences, it would be much easier to intercept a salvo of four large, high-flying targets with a larger RCS than 24 smaller, lower-altitude, lower-RCS targets. Beyond being easier to shoot down, the adoption of ATACMS would impose some other negatives onto the Ukrainian side. A battery of ATACMS-equipped HIMARS would be able to engage far fewer targets per salvo, and would require much more frequent reloading, greatly decreasing their combat uptime. Additionally, frequent reloading would require the platforms to spend more time in once place, where they may be vulnerable to enemy strikes.

The primary advantage of ATACMS would be the ability to engage more distant targets, however exploiting this to the full would require good knowledge of Russian air defence positioning in order to avoid the missiles being engaged. While this could theoretically be possible with Ukraine's access to US intelligence, such strikes would require more planning than GMLRS, whose saturation potential allows it to be used more flexibly. As such, in most tactical situations Ukraine would benefit more from additional GMLRS rather than ATACMS, because volume and saturation potential are more important than range within Ukraine's operational context.

Photo: USAF



Image shows an early variant of the AGM-88 HARM on display in a hangar at the Spangdahlem air base in Germany. Ukraine is understood to have been provided with older variants of HARM, probably the AGM-88B/C variants.

HARM is likewise probably not a silver bullet in the context of Ukraine. On paper, it is a useful tool for dealing with air defences, but in practice there are a number of obstacles which prevent Ukraine from using the weapon to its fullest potential in this particular role.

For starters, assuming the integration with Ukraine's MiG-29 aircraft resulted in no major issues, there is the issue of training Ukrainian pilots to use it effectively in the Suppression of Enemy Air Defences (SEAD)

or Destruction of Enemy Air Defences (DEAD) roles. This would require time and impose an opportunity cost, since a squadron going through training in such highly specialised mission types could not be expected to participate in other missions at the same time. Secondly, even with HARM integrated, Ukraine's aircraft lack AN/ASQ-213 HARM Targeting System (HTS) pods, without which targeting HARM effectively can be difficult, according to a former US 'Wild Weasel' pilot.

Furthermore, undertaking SEAD/DEAD missions would require Ukraine's air defences to be able to reliably carry out airspace deconfliction to avoid fratricide. This would not be straightforward, given that Ukraine's air defences broadly lack the C2 sophistication for reliable deconfliction and operate in a contested electromagnetic (EM) spectrum environment. Additionally, portions of Ukraine's air defences are reliant on distributed MANPADS teams without access to a C2 network, and largely reliant on visual target confirmation, further complicating deconfliction.

Lastly, HARM itself has been criticised by some former US pilots, who have stated that it is difficult to use due to the attitude of the aircraft at launch affecting the accuracy of the HARM's inertial navigation system (INS), and for the missile losing accuracy after air defenders turn their radars off. Pilots have also stated that warhead is insufficiently large for the weapon's relatively low level of precision, sometimes resulting in damage to the target rather than destruction, making it overall less desirable than other weapons for engaging air defences.

Even without these challenges, executing the SEAD/DEAD mission set against Russian air defences would be still extremely risky, and Ukraine's armed forces fully understand the danger they pose, as noted by Dr Jack Watling on the 'This Means War' podcast: "The air side is, I think, an interesting picture, and this comes back to that point about people not understanding Russian weapon systems. The Russian Air Defence systems work, and they are as problematic as we thought they were against fourth-generation platforms. They are lethal, highly effective, and rather like Russian electronic warfare is a huge enabler of the Russian Forces because it just denies the airspace. The Ukrainian planning assumption is: fly target drones into an area, if it gets lit up by air defences, don't go there with aviation or fast air."

For these reasons, the most viable way for Ukraine to employ HARM (depending on the variant) would probably be as an enabler for strikes from other weapons. In this role, the HARM would not be employed for serious SEAD/DEAD missions, but would instead be air-launched blind toward a target area containing Russian air defence systems. At the same time, other munitions, such as GMLRS rockets, would target the object being protected by the air defence systems. Employed this way, the HARM would be launched in a 'pre-briefed' mode in which the missile flies toward a designated area while the seeker searches for radar emissions in-flight. Upon detecting the HARMs, Russian air defences are incentivised to shut

Photo: Russian MoD



Artillery has played an incredibly important role in the War in Ukraine for both sides. In the absence of significant contributions by air power, artillery has been the de facto means of carrying out long-range strikes. At present Russia retains broadly still fires superiority, but Ukraine's receipt of more accurate systems may help it tilt the balance in its favour over time, or attain local fires superiority in specific cases.

off their radars or switch to a reduced-capability mode, making it significantly more difficult for them to carry out interceptions of the other munitions on their way to the target. Russian short-range air defences may also attempt to intercept the HARMs, but even if they are successful, HARM will have done its job. This is because HARM's presence in the mix of threats will increase the overall number of targets Russian air defences have to deal with and cause them to expend ammunition on less-important targets.

This means of employing HARM would be unlikely to result in many casualties among Russian air defences, but would probably result in more of Ukraine's other munitions reaching their targets. This would also be a noteworthy example of Ukraine layering their strike capabilities to better adapt to and shape the operational conditions of the battlefield. However, to many outside observers this valuable effect would be largely invisible.

A Long Road Ahead

Observers would do well to remember that there is much of the war they can't see, and that images or video footage should be treated with caution. Each one is like a single pixel in a much larger obscured image, and they are often presented by actors with their own political perception-oriented goals. The War in Ukraine is as much a propaganda war as it is a kinetic war, and neither side regularly release footage of their own equipment being destroyed, nor regularly report combat casualty figures. There are very good reasons for doing so – not only is it bad for domestic morale, but in Ukraine's case keeping the international community's flow of equipment, training and support going requires convincing them that this war is winnable. Reporting their own side's losses is therefore counter-productive to achieving this goal because it could cause international confidence to waver.

Consequently, there will often be major discrepancies between the effectiveness of weapons in the lived experience of soldiers and the public perception of their effectiveness. This focus on individual weapon systems also tends to skew attention away from the bigger picture. Fundamentally, many of the armaments delivered to Ukraine have largely helped Ukraine's soldiers to be better at doing what they can already do. As the Donbas conflict from 2014-2022 showed, Ukraine has not struggled to knock out individual Russian tanks or armoured vehicles in a defensive war. Footage of their capacity to do the same thing with NLAWS or FGM-148 JAVELIN does not provide any particularly meaningful insights, and draws attention away from the serious operational challenges they face ahead. What Ukraine lacks more than any single weapon system is the freedom to mass their forces for meaningful counteroffensives which can influence the wider balance on the battlefield. Here Russia's artillery has served in a crucial, but largely invisible capacity, preventing Ukrainian forces from massing together by its presence. It has done so in spite of many of its systems being older or sometimes less accurate than their Western counterparts. This has had a profound impact on the war, because it has restricted Ukraine's freedom to do what it needs to do in order to win.

There is no individual wunderwaffe that can resolve this problem, however there are potential combinations of different weapons, operational practices, and tactics which could allow Ukraine to gradually shape the battlespace in their favour over time. Long-range precision fires in the form of HIMARS was a start in this direction, and HARM would seem to be a means of reinforcing that. However, these capabilities alone cannot be expected to shift the balance. Unless they are coupled with effective practices and tactics which change the underlying conditions of the battlespace, they will merely inconvenience their opponent rather than dealing a decisive blow. ■

Masthead

European Security & Defence

Issue 10/2022, October 2022

ISSN 1617-7983 - www.euro-sd.com

Published by



Mittler Report Verlag GmbH

A company of the TAMM Media Group

Publisher and Editor-at-Large: Stephen Barnard (sb)

Editor-in-Chief: Jürgen Hensel (jh)

Designated Editor-in-Chief: Mark Cazalet (mc)

Editorial Staff: Rolf Clement (rc, Political Affairs), Waldemar Geiger (wg, Infantry, Industry), Wolfgang Gelpke (wge), Gerhard Heiming (gwh, News, Land Forces), Rolf Hilmes (rh, Army Technology), Hans-Uwe Mergener (hum, Naval Forces)

Online Editor and Webmaster www.euro-sd.com: Jack Richardson (jr)

Copy Editor: Christian Kanig (ck)

Regional Correspondents

Belgium/EU/NATO: Joris Verbeurgt (jv), **Brazil:** Roberto Guimarães de Carvalho (rgc), **Denmark:** J. Bo Leimand (jbl), **France:** David Saw (ds), **Georgia:** Beka Kiria (bk), **India:** Suman Sharma (ss), J C Menon (jcm) **Israel:** Tamir Eshel (te), **Italy:** Luca Peruzzi (lp), **Japan:** Shinichi Kiyotani (sky), **The Netherlands:** Jaime Karremann (jk), **Poland:** Grzegorz Sobczak (gs), **Portugal:** António Brás Monteiro (abm), **Regional Correspondents, Russian Federation:** Sergey Kirshin (sk), Yuri Laskin (yl), **Spain:** Esteban Villarejo (ev), **Taiwan, North & East Asia:** JD Kitsch (jdk), **Turkey:** Korhan Özkilinc (kÖ), **UK:** Christopher Foss (cf), Tim Guest (tg), **Ukraine:** Alex Horobets (ah), Reuben F Johnson (rfj) **USA:** Sidney Dean (sd), Chet Nagle (cn)

Layout:

AnKo MedienDesign GmbH, Germany

Production:

Lehmann Offsetdruck und Verlag GmbH, 22848 Norderstedt, Germany

Office Address:

Mittler Report Verlag GmbH

Beethovenallee 21, 53173 Bonn, Germany

Phone.: +49 228 35 00 870, Fax: +49 228 35 00 871

info@mittler-report.de, www.mittler-report.de

Managing Director: Peter Tamm

Editorial Director: Lars Hoffmann (lah)

Authorised Signatories: Waldemar Geiger, Lars Hoffmann

Advertising, Marketing and Business Development

Stephen Barnard

Phone: +49 228 35 00 886, Mobile: +44 7984 033154

stephen.barnard@mittler-report.de

Stephen Elliott

Phone: +49 228 35 00 872, Mobile: +49 1590 173 0346

stephen.elliott@mittler-report.de

Waldemar Geiger

Phone: +49 228 35 00 887

waldemar.geiger@mittler-report.de

Dr. Andreas Himmelsbach

Phone: +49 228 35 00 877

andreas.himmelsbach@mittler-report.de

Advertising Representative, Russia & CIS:

Laguk Co., Yuri Laskin, General Director

Krasnokholmskaya Nab., 11/15, 132, RF-109172 Moscow, Russian Federation

Phone: +7-495-911-1340, Fax: +7-495-912-1260, Email: yury.laskin@mittler-report.de

Exhibition Management and Advertising Administration: Renate Herrmanns

Advertising Accounting: Sabine Rump

Subscription/Reader Service:

PressUp GmbH, PO Box 70 13 11,

22013 Hamburg, Germany

Phone: +49 40 38 66 66-319, Fax: +49 40 386666-299

Email: mittler-report@pressup.de

European Security & Defence, © 2022 Mittler Report Verlag GmbH

The contents of this issue appear under the responsibility of the BAAINBw.

All rights reserved. No part of this publication may be reproduced without prior written permission of the publisher in Bonn.

Cover Photo: A still from the US Navy's 19 March 2020 test launch of the Long-Range Hypersonic Weapon (LRHW) at their Pacific Missile Range Facility in Kauai, Hawaii. (US Navy) (Photo: US Navy)

Annual subscription rate: €82.50 incl. postage

Reduced annual subscription rate for distribution in Germany:

€64.90 incl. postage

Infantry Load-Carrying Options

André Forkert

Rucksack, knapsack, packsack, pack, Haversack, or Bergen – whatever term you use, it's simply a bag to put on your back, with two shoulder straps, often with many pockets or several compartments. You call it, it is the simplest way to carry your gear easily, safely and over long distances.

Large backpacks, used to carry loads over 10 kg usually offload the major part of their weight onto padded hip belts. This leaves the shoulder straps mainly for keeping the load in place making it easier to carry heavy loads because the hips are stronger than the shoulders. It also improves agility and balance, because the load lies closer to the centre of mass of the person wearing it.

Photo: André Forkert



The Berghaus Fight Light System (FLT)

The Rucksack

The term backpack was coined in the United States in the 1910s. Prior to backpack, moneybag and packsack were used. The word rucksack is a German loanword mainly used in the UK, US and in other Western military forces. In Middle High German, ruck(e) means "back" (dorsum), which led to the Upper German word ruggsack. The name rucksack is cognate with the Danish ryg-sæk, Norwegian ryggsekk, Dutch rugzak, Afrikaans rugsak, Swedish ryggsäck, and Russian рюкза́к (rjukzak). Alternative names include Kraxe (a German rucksack with a rigid framework), and Bergen (a large load-carrying rucksack, from a design issued by the British Army during the Second World War). In fact, British troops used to call their Alpine-style backpacks "Bergens", maybe from the name of their creator, Norwegian Ole F. Bergen, combined with the name of the Norwegian city of Bergen.

Famous within military circles is the Tornister (from Switzerland: Infanterie-Felltornister), a form of rucksack in which a fur or fabric covering is sewn over a rectangular wooden or plastic frame. They were also known as monkeys because of the fur covering. Later, the German Gebirgsjägersack came along, made of leather and fabric, and a few generations later in the US Army, the

to the Swedish Armed Forces, and Tasmanian Tiger (Tatonka GmbH) supplied a total of up to 60,000 systems. The 110-litre system consists of a 110-litre backpack, a 30-litre daypack and six packliners (two packliners each of 8, 20 and 40 litres). The packliners are waterproof bags that can be carried as inliners in the backpack or in the side pockets. The supply contracts for the packliners were secured by Logistik Unicorp Inc from Canada and Wise Pearl Ltd from Hong Kong. In addition to the requirement for the size of the backpacks, a specific material as well as front and top loader concepts were demanded by the armed forces. This allows them to be loaded from the top as well as from the front. The side pockets of the main backpack are detachable and can be used individually or combined as an emergency backpack if required. Meanwhile, another contract - for 250,000 systems - has been awarded to Snigel Design AB to fully equip the Bundeswehr. The timetable is ambitious,

All-Purpose Lightweight Individual Carrying Equipment (ALICE) system, a carrying frame backpack. To this day, the US Armed Forces use similar systems, except that the heavy and sharp-edged metal frame has given way to a lightweight and body-hugging plastic frame. For US airborne forces, the Modular Lightweight Load-Carrying Equipment (MOLLE) 4000 backpack system was introduced in 2019. "The new MOLLE 4K is a compilation of the best parts of the legacy ALICE pack and the newer MOLLE," according to Capt. Fritz Carr, commander of the US Army Advanced Airborne School. The 4000 "moniker" addresses the cubic inches of load volume and replaced the ALICE rucksack.

The German Armed Forces introduced the 110-litre system for infantry and special forces years ago. It consists of the Berghaus ATLAS IV 110 litre and the Berghaus MUNRO daypack with 35 litres. This system was recently supplemented or replaced by a new 110 litre system in two variants. Snigel Design AB, the main supplier of backpack systems



Photo: Eberlestock

The Eberlestock F1 mainframe carrying system

Author

André Forkert a former infantry officer, is Co-Editor of the German website www.soldat-und-technik.de.

with the Ministry of Defence expecting to receive the equipment by 2025 at the latest.

New Berghaus System

In the meantime, Berghaus has also developed a new system. This was presented in March 2022 at the EnforceTac in Nuremberg, Germany, by the sales partner LV Equipment BV. The Fight Light System (FLT) comprises 18 new products, from the Big Bag Pack to the small Gear Bag. These are essentially the well-known MMPS CRUSADER systems, with some additional enhancements and in new, significantly lighter material and a stone-grey colour (RAL 7013). Thanks to the new and lighter material, a considerable weight saving has been achieved and a special coating makes them practically invisible to infrared detection. In addition to the MMPS CRUSADER, the FLT TITAN 60 FA-IR, HEROS 45 FA-IR, HEROS 35 FA-IR or ARES 25 IR will also be available. New to the range are FLT Stash Pack side bags, cargo bags, organiser bags or medical bags. However, the range is not intended as a replacement for the 110-litre system introduced by the Bundeswehr, but as an additional system. FLT is the latest development from Berghaus' tactical line. The lightweight load carrying system (LCS) contributes to a higher individual performance of the soldier without sacrificing important features or comfortable load transfer. All backpacks are made of 560 dtex polyamide and thus meet the technical delivery conditions TL 8305-0278 of the German Armed Forces, including high-quality infrared protection. The backpacks can be equipped with a wide range of accessories to meet almost all operational requirements.



Photo: Dutch MoD

The new 110-liter backpack of the NLD Army in test and evaluation.

They are equipped with Accessory Connector Hooks (ACH), specially developed and hardened aluminium hooks that allow safe but quick attachment and removal of all equipment pouches and inlets.

Ghosthood Backpacks

The camouflage specialist CONCAMO Ghosthood has announced its own backpack family. Thanks to the arrangement of various zips, the backpack allows access from all sides and in all positions. There is also no need for a camouflage cover, as the

material takes care of this task right away, including IR camouflage. An EOD backpack with a volume of around 20 litres was developed as the first variant.

All-in-One System

With the HL 334, Lindnerhof Taktik offers a tactical backpack that can be integrated directly into the combat waistcoat. With a volume of 10 litres, it can be used as a stand-alone rucksack or attached directly to the shoulder strap or back section of the plate carrier via clips. The HL 334 can also accommodate hard ballistics and replace the back section of the plate carrier. This makes the system highly flexible and modular, as well as fast, light and slim. The HL 334 was developed together with a European authority. The Dutch Armed Forces have just procured the Individueel Soldaat Systeem (ISS), with Elbit Systems as the prime contractor. This modular combat equipment includes the combat equipment "Verbeterd Operationeel Soldaat Systeem (VOSS)" and the clothing system "Defensie Operationeel Kleding Systeem (DOKS)". Marom Dolphin supplies the plate carrier, bags, backpacks, tactical belts and soft ballistics. The motto here is: "One system fits all". The backpack and transport solutions form a unit with the plate carrier and the waist/weapon belt. The plate carriers can flexibly accommodate soft and hard ballistics, thanks to different compartments in combination or as a single solution. This provides the wearer with a quick and flexibly adaptable solution. Thanks to the TPP connector, the plate car-



Photo: André Forkert

FJELL PULKEN from Cold Skills for missions in snowy areas.



Photo: Andre Forkert

First backpack by Ghosthood.

rier is connected to the tactical belt, thus transferring the weight of the plate carrier to the hip. And all this while retaining full freedom of movement. The same principle is used for the backpacks, which can be adjusted in height and are also connected via TPP. Their weight is also transferred primarily to the hips. All the units have a fast release so that they can be thrown off quickly in an emergency. Marom Dolphin is distributed in Germany by Messer Waffenhandel.

Packs for Special Forces

For some time now, and with a budget that has been available for years, the Bundeswehr's special forces have intended to procure a new rucksack family through the Special Forces Command (KSK). The aim of this backpack family is to replace the previous 110-litre system and to provide a continuous family from the daypack to the heavy-duty backpack based on a Kraxe. The family also includes backpacks for specialists such as the long-range reconnaissance soldier, medic or sniper; it also includes the cover systems.

The backpack supplier of the United States Special Operations Command (USSOCOM), Mystery Ranch, is also a hot candidate here. This manufacturer is known for being able to offer not only standard backpacks, but also many specialised solutions for mortar, sniper or telecommunication squads. The materials used are mainly 330D Lite and 500D CORDURA. Since the manufacturer is primarily in the top price segment, a somewhat more cost-effective series was developed with the "International Line". This is BERRY compliant, intended for sale in the USA and now includes more than 12 different backpacks, ranging from daypacks to 110-litre systems. Unlike the previous backpacks, the International Line is no longer manufactured in the USA but abroad. However, it is said to be in no way inferior to the originals in terms of

durability and resilience. Mystery Ranch is distributed in Germany by Lindnerhof Taktik GmbH.

The RECON 125 L Synkroflex pack from Norøna was developed in cooperation with the Norwegian special forces, and Denmark is also introducing it. The Recon Synkroflex is the "king of backpacks", according to the manufacturer. The pack has been approved by the Norwegian, Swedish and Danish militaries and holds up to 125 litres. It is suitable for even the heaviest and bulkiest loads. Designed for carrying extremely heavy loads for extended periods of time, the pack is constructed around a unique aluminium frame that provides stability, balance and comfort. The design ensures that weight is distributed evenly across the anatomically shaped back, frame, shoulder straps and hip belt and is tailored to body movement. The backpack has a wide range of flexible solutions and is made of an extremely durable material. This allows the "bag" to be removed from the frame and strapped to a box or barrels similar to a Kraxe. It also includes two spacious and removable side pockets that can be zipped together to create an additional 16-litre backpack. It is made of ECONYL yarn, the latest generation containing recycled materials. The tare weight is 4,674

Photo: Andre Forkert



Drone-Carrying System by LindnerhofTaktik, based on Mystery Ranch.

grammes. The special feature is the Synkroflex Carry System with the "back plate" separated from the rest. The frame is easily and quickly adjustable for any size and is also decoupled so that no up-and-down movements of the load are transmitted. The pelvic belt takes the load but is also decoupled and thus absorbs lateral swaying movements. Even heavy loads around 25 kg feel more like 5-7 kg with the backpack compared to a standard backpack.

Notably, in the field of rucksacks, many suppliers are offering modern solutions. For example, the TATONKA Lastenkraxe with packsack 2 has a net weight of 2.7 kg and can be used with or without a packsack (80 litres) and up to a load of 50 kg. The Kraxe consists of an aluminium frame, the robust packsack is made of 420 nylon material in the "High Density" (HD) version, and Cordura 500 was used for the base. Another example is the Eberlestock F1 mainframe carrying system. Simply put a waterproof packsack on the Kraxe and you're done. The tubular aluminium frame weighs 1.9 kg and is extremely strong, despite its ultralightweight properties. The system has been tested to 317 kg.

Since 2012, US Army researchers have been working with Lightning Packs LCC to refine a special backpack technology that enables infantry soldiers to generate small amounts of up-and-down energy as they walk, run, or otherwise operate in the field. The company's backpack technology can generate as much as 7.4 Watts of electricity when the wearer is walking -- enough to power or recharge an MP3 player, night-vision goggles, three LED headlamps, a handheld computer, CMOS image decoder, or handheld GPS. The solution was presented at different defence fairs, but it is unknown if it has ever been fielded.

From Air to Land

Infantrymen or special forces units do not always arrive by land or on foot with 4x4 vehicles, instead, they often use vertical insertion.

To carry the large and heavy backpacks, the US Marine Corps uses the Parachutist Drop Bag (PDB) from Complete Parachute Solutions (CPS). This is a multi-function, jumpable drop bag that can be configured for both military freefall and static line operations. The bag comes in three standard sizes or can be customised to meet user requirements. Germany uses the SGE-006 jump bag from Spekon Sächsische Spezialkonfektion. The Dutch and Belgians use a jump bag from the German company Paratec for their "Ensemble de Parachutage du Combattant" (EPC) parachutes. The Dutch have just ordered an additional 240 systems. In parallel, Germany is having Safran develop a multi-mission harness for the new EPC parachutes. This harness should be able to carry a large number of different backpacks - in different sizes - and with a maximum weight of 80 kg. The overall system also includes a multi-weapon harness that can carry a variety of different, and also heavy, handguns. If backpacks are insufficient, so-called door loads and heavy loads are used.

MAIBACH Industrie-Plastic GmbH offers appropriate solutions on a glass fibre reinforced plastics basis for air transport. In the case of the transport and storage containers (TuLB), the customer can rely on 35 standard sizes that are immediately available in accordance with standard VG 95613. These are also drop-proof and break-proof according to MIL-STD and VG 95613, corrosion-resistant, pressure- and vapour-tight up to 100 mbar and air-loadable according to LTR 8145. And MAIBACH MILTAINER - RM are reusable, available in seven standard sizes (alternatively customised), fully inter-stackable unlike-sized cases, outfitted with special corrosion-proof recoil spring levers, fasteners and snap-back grip handles and are impact and water-vapour proof (optional). MILTAINER - RM are versatile application possibilities designed to withstand any amount of wear and tear. They protect against impact and stress, e.g. when dropped. Sensitive equipment is protected against vibration, humidity, moisture and dust, in all climate zones and under harsh environmental conditions. All MILTAINER - RM are certified for air transport.

Similar solutions are also available from PELI with the Single Lid Cases and RACK Cases. The latter can also integrate a 19-inch frame and thus accommodate IT. Single Lid: Thanks to Memory Foam, dents disappear over time.

Particularly in the area of special forces, many nations rely on so-called Guided Precision Aerial Delivery Systems (GPADS)



Photo: André Forkert

Based on the NICE Frame from Mystery Ranch, Lindnerhof Taktik has developed a transport solution for larger tactical drones.

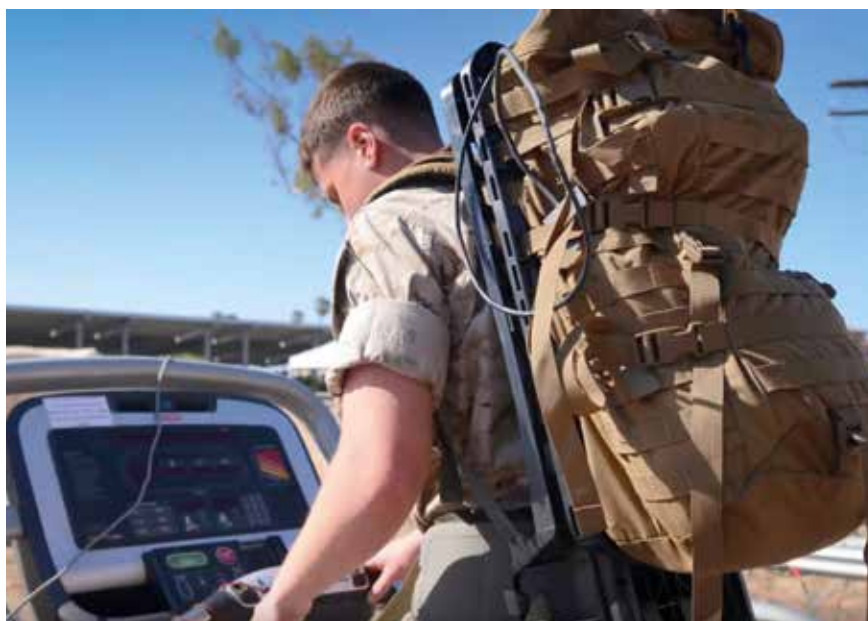


Photo: Lightning Energy LLC

The Lightning Pack can produce energy as the wearer moves.

for follow-up supply. If the GPADS can no longer be recovered - e.g. water landing - Airborne Systems offers two more cost-effective variants for one-off use. The FC MINI is not an alternative to the MicroFly II and uses the MC-4 glider and can deliver a payload of up to 227 kg. It can drop from altitudes of up to 7,468 m using the static line. Another system is the FlyClops 2K with a payload of up to 998 kg.

Load Cart

The infantry in particular wants to use Unmanned Ground Vehicles (UGV) in the Multifunction Utility/Logistics and Equipment (MULE) role in the future. Most countries are still testing extensively. The UGVs can autonomously - via GPS control - transport loads or operate in follow-me mode. But they are often large and heavy. A transport solution that works like a UGV but is much lighter and suitable for off-road use is WILD GOOSE by Marom Dolphin. With this tactical hauler, the aim was to design a system that meets all infantry requirements; it does so by being attached to the waist belt of the combat waistcoat and pulled by the user. The locomotion is electrically assisted, so the payload is hardly noticeable. The Robotic System is available in 4x4 and 2x2 versions, which are extensions. The 4x4 can carry 140 kg and the 2x2 75 kg of payload. The system's own weight of 28 kg (for the 2x2) and 48 kg means that it can be carried over obstacles by two soldiers. The range of the battery charge is given as 25 km (off-road) thanks to the large wheels. Because of its sensors,



Photo: André Forkert

Marom Dolphin combines tactical vest, combatbelt and backpack into one system.

the latest version can also be controlled remotely by joystick and can drive or follow about 50 m ahead. Remote control, also non-line-of-sight (NLOS), is being introduced, and full autonomy should also be possible in the future.

Cold Skills from Sweden offers the FJELL PULKEN (Mountain Pulken) for transporting equipment or injured people in snowy terrain. TAIGA's camouflage solutions - IR and UV - have been integrated into this "pull sled". The vehicle is very light - less than 5 kg - and can be pulled by a soldier using a waist belt. The "sledge" is available in lengths of 154 cm, 168 cm and 188 cm.

Military Trucks Get Harder

Christopher F Foss

As the threats facing military personnel today are of a different kind, crew protection systems are increasingly being fitted to military trucks.

In the past, military trucks tended to operate in the rear area, carrying vital ammunition, food, fuel and other essential supplies to front line units and were not expected to come into direct contact with enemy forces and were therefore not normally protected.

During operations in Afghanistan and Iraq, trucks were needed to keep outposts supplied with essential supplies and these soon came under regular attack, not only from small arms fire but also rocket propelled grenades (RPG), mines and improvised explosive devices (IED) which resulted in the total loss of the truck, its crew and valuable supplies. This led to the rapid fielding of trucks with a protected cab to provide their occupants with a higher level of protection against an increasing wide range of threats.

Photo: Christopher F Foss



French Army Nexter Systems CAESAR 155 mm/52 calibre self-propelled artillery system fitted with a fully enclosed protected cab.

Applique Armour

Today, some vehicle cabs are supplied fitted for but not with a passive applique armour package, as in normal peacetime training there is simply no need for additional armour protection, which in some cases can restrict the drivers view when travelling on civilian roads and also reduces its payload. Many other military vehicles are supplied with a very well protected cab, which is usually of welded steel to which an applique armour package is fitted from the beginning. Special bullet/splinter proof windows are also fitted to these well-protected cabs, but in some cases, these are much smaller than the normal windows so have tended to restrict observation, especially to the front and sides.

Author

Christopher F Foss has been writing on armoured fighting vehicles and artillery systems since 1970. He has also lectured on these subjects in many countries as well as chairing conferences all over the world. He has now driven well over 60 tracked and wheeled armoured vehicles.

Exact ballistic protection levels depend on the end users requirements and where the vehicles are to be deployed but are usually to STANAG 4569 Level 2 or 3 which is small arms fire up to 7.62 mm attack. To provide higher levels of protection would make the cab much heavier and more expensive. For a higher level of protection against RPG fitted with a single high-explosive anti-tank (HEAT) warhead, the cab could also be fitted with bar/slat armour, which is positioned away from the cab to neutralise the fuse of the warhead before it can be activated.

Net-Type Protection

An alternative to bar/slat armour is the British AmSafe Bridport TARIAN RPG series net device, which was developed by the company in partnership with the UK Defence Science and Technology Laboratory (DSTL). The first generation system was fitted to the cabs of some British Army Oshkosh Defense M1070F (8x8) Heavy Equipment Transporters (HET) initially deployed to Iraq. More recently, the

latest generation TARIAN has been fitted to some of the General Dynamics Land Systems FOXHOUND (4x4) Protected Patrol Vehicles deployed to Mali. This is a light weight net type solution which is much lighter than bar/slat armour and in addition provides increased visibility for the crew and has also been sold overseas for installation on armoured fighting vehicles (AFV) with the Danish Army being the first export customer.

QinetiQ North America has supplied large quantities of its Q-Net protection systems for not only the US armed forces but also foreign customers for installation on trucks as well as AFVs. According to the company, this is between 60% and 70% lighter than bar/slat armour and can be easily configured to install on all types of military vehicles, including trucks.

Engine Protection

In forward control cabs, the engine tends to be more to the rear while others have the engine at the front with the cab to the immediate rear. In some cases, the engine is protected as well, although not

to the same high level as the cab as the crew are the most valuable asset.

Well-protected cabs normally have door opening and closing devices as the weight of the armoured door is so heavy that if the vehicle is on a side slope or at an angle the door is difficult to open manually to allow rapid exit of the crew. The forward control cab can normally be tilted forward to allow for access to the power pack for maintenance purposes, but when fitted with a fully protected cab, additional power assistance is required.

As the bullet/splinter proof windows cannot be opened, the fully enclosed and protected cabs are usually supplied with an air-conditioning system and a roof-mounted protected weapon (PWS) typically armed with an un-stabilised 7.62 mm or a 12.7 mm machine gun (MG). Some high-value trucks have a roof mounted remote weapon station (RWS) armed with a stabilised weapon which can be laid onto the target from with the cab in complete safety using a day and night sighting system. Some have also been fitted with banks of electrically operated smoke grenade launchers.

As previously stated, one of the main threats during counter insurgency (COIN) type operations has been IED attack and for this reason, many trucks deployed on operations are fitted with electronic counter measures (ECM) at the front in order to neutralise IED. The cab can also be fitted with blast attenuating seats, communications and a battle manage-



Photo: Iveco Defence Vehicles

Iveco Defence Vehicles in Italy have delivered this TRAKKER (8x4) to the Germany Army with a cargo body and a fully enclosed protected forward control cab.

ment system (BMS), all of which require additional electrical power so the electrical system of the platform will also need upgrading and additional batteries installed.

Many of these cab sub-systems such as PWS/RWS, weapons, communications and ECM equipment are provided by the end user as government furnished equipment (GFE) for fleet commonality. While brand new trucks can be fitted with a fully protected cab, some countries have removed the existing unprotected cab and replaced this with brand new fully

protected cab. This is not only an expensive option but the fully protected cab is also much heavier and the front suspension has to be upgraded or replaced to take into account the additional weight; otherwise the mobility of the vehicle will be degraded and its payload reduced.

The US company Firetrace Aerospace have supplied huge numbers of their fuel-tank fire suppression systems which are standard on many US platforms. A typical contract was for 6,696 kits for installation on the US Army Oshkosh Defense Heavy Expanded Mobility Tactical Truck (HEMTT) (8x8).

Rheinmetall MAN Military Vehicles has shown one of its military trucks fitted with a hard-kill active protection system (APS) but as far as it is known this has not been adopted by any country, although sales have been made for AFV applications as they are very expensive and difficult to integrate onto some platforms due to space problems. A hard-kill APS provides the platform with protection against not only RPG type threats but also anti-tank guided weapons (ATGW).

Arqus Defense

Arqus Defense (previously Renault Trucks Defense) are the major military truck manufacturer in France and supply the complete 6x6 chassis for the Nexter CAESAR 155 mm/52 cal self-propelled artillery system used by the French Army and an increasing number of export customers. This chassis is built at their Limoges facility complete with a fully protected cab and is then sent to Nexter in Roanne where the complete 155 mm/52



Photo: Christopher F Foss

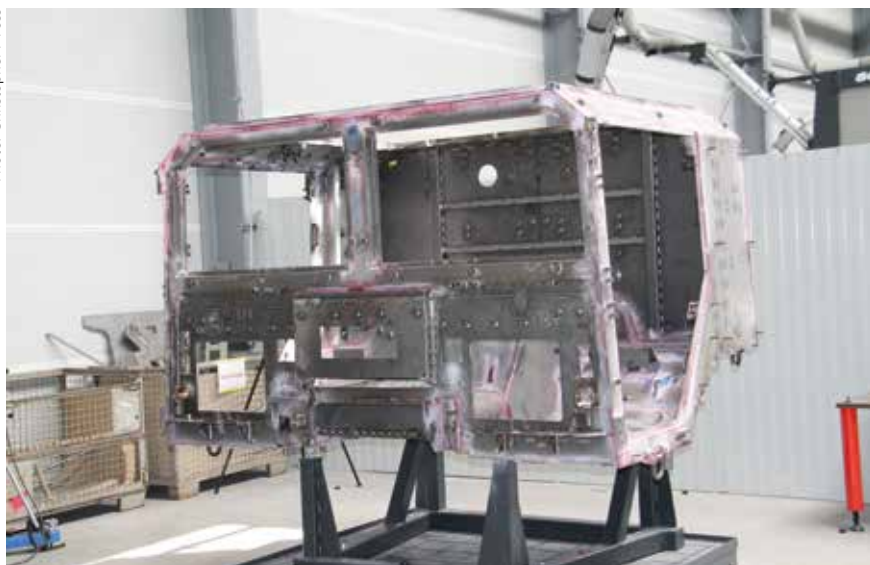
Standard British Army RMMV (4x4) cargo truck fitted with forward control cab and showing mounting points for additional passive armour package

Photo: RMMV



British Army Rheinmetall MAN Military Vehicles (8x8) with forward control cab fitted with bar/slat armour, wire cutters, protected weapon station and electronic counter measure devices

Photo: Christopher F Foss



Integrated Armoured Cab for Rheinmetall MAN Military Vehicles on the production line prior to being completed and showing mounting points for applique armour

Photo: Navistar Defense



US Navistar Defense MaxxPro recovery vehicle fitted with protected cab, Q-Net protection system to front and sides of cab and roof mounted device to counter improvised explosive devices

calibre weapon and other sub-systems are fitted. While France uses an Arqus Defense chassis for the CAESAR, other customers use other chassis, for example Tatra (8x8) or Mercedes-Benz UNIMOG (6x6). Arqus Defense has already upgraded many French Army GBC 8 KT (6x6) 4 tonne cargo trucks to a new standard called BC 180 (6x6) 5 tonne truck with the cab to the rear of the power pack having an optional applique armour package.

Using internal research and development funding, Arqus Defense has developed a new generation of military trucks called ARMIS. These are being marketed with the option of a protected cab. This family will be offered to the French Army to meet its future truck requirements, which is expected to be an open competition.

RMMV

Rheinmetall MAN Military Vehicles (RMMV) cross-country trucks are manufactured at their facilities in Vienna, Austria, while the protected cabs are manufactured in a purpose-built facility in Unterlöss which has so far completed well over 2,500 cabs.

RMMV trucks can be fitted with the top of the range Integrated Armoured Cab (IAC) or the Modular Armoured Cab (MAC). The latter is provided with applique armour kits, which are fitted when the vehicle is deployed on operations rather than being installed on a day-to-day basis.

To increase local content, there is a trend to involve local suppliers and a good example is the UK contract with Marshall supplying the rear truck bodies for 4x4, 6x6 and 8x8 cargo trucks and EKA the recovery hamper for the 8x8 recovery vehicle. The first small batch of RMMV (the competition was actually won by MAN Truck & Bus) cargo trucks for the UK have an unprotected forward control cab and are used for driver training. Follow-up vehicles were fitted for but not with an applique armour package and for deployment in Iraq and Afghanistan, further survivability enhancements were made. These included a fully protected cab with bar/slat armour, wire cutters, PWS and electronic devices to counter IED.

Other Suppliers

Iveco Defence Vehicles of Italy have supplied fleets of military trucks to many countries including France, Germany

and Italy, with all of these being of the forward control type.

The US Oshkosh Family of Medium Tactical Vehicles (FMTV) are produced in 4x4 and 6x6 configurations with the option of a fully protected forward control cab. Applique armour packages are supplied by a number of contractors, with the Israel company of Plasan having supplied well of 35,000 applique armour kits as well as supplying vehicles fitted with their armour packages including 4x4 vehicles such as the SAND CAT. In response to a question by European Security & Defence, Plasan declined to confirm that they had supplied any protected cabs.

Rheinmetall Protection Systems of Germany, which includes the world-famous IBD company, can supply complete passive protection packages for a variety of platforms including trucks.

NP Aerospace of the UK has supplied applique armour packages for many vehicles at home and overseas as well as supplying protected vehicles based on a Land Rover DEFENDER (4x4) or Mercedes-Benz G-WAGON (4x4) chassis, but these are no longer marketed.

Most Russian military trucks are un-armoured but a few URAL (6x6) with a protected cab have been encountered in recent fighting in the Ukraine.

As previously stated, the CAESAR 155 mm/52 cal SP artillery system can be supplied with a protected cab but for some artillery systems, this is standard as the vehicle is delivered.

Examples of this are the UK Lockheed Martin Missiles & Fire Control M142 High Mobility Artillery Rocket System (HIMARS) (227 mm – 6 round) which is based on the Oshkosh FMTV (6x6) truck chassis.

Another example is the Swedish BAE Systems Bofors ARCHER 155 mm/52 calibre (6x6) artillery system based on a Volvo chassis, which has a fully protected air-conditioned cab, and a roof-mounted Kongsberg RWS armed with a 12.7 mm MG. In addition to trucks and other tactical vehicles being fitted with protected cabs, some countries have fitted their key engineer support vehicles with protected crew cabs including bulldozers and graders, as during COIN operations these can come under direct fire.

Penman of the UK upgraded a significant number of engineer vehicles for the Royal Engineers, including Caterpillar 938 wheeled loaders which when fitted with the fully enclosed Penman Crew Protection System (CPS) were called Wheeled Loader – Protected. ■

Photo: Penman



British Army Caterpillar Wheeled Loader fitted with Penman Crew Protected System for higher operator survivability and with bucket in raised position

Photo: AmSafe Bridgeport



British Army FOXHOUND (4x4) Protected Patrol Vehicle fitted with TARIAN RPG net protection system

US Army Introduces Drone Swarms into its Training

Sam Cranny-Evans

The US Army has introduced a swarm of 40 Unmanned Aerial Vehicles (UAVs) into its opposition force scenarios at the National Training Center (NTC) in California, according to an 11 September 2022 tweet by Brigadier General Curtis Taylor, the NTC's Commanding General.



Photo: Pte. Austin Anyezekwu/US Army, via Wikimedia Commons

The US Army has started to employ drone swarms at its National Training Center (NTC) in order to better prepare its troops for deployments in modern conflicts.

The footage showed the drones advancing as the first part of an assault led by the 11th Armoured Cavalry Regiment (ACR) against the 1st Armoured Division. Each of the quadcopters was equipped with a camera, they were capable of carrying a lethal munition and, for the purpose of the exercise, were equipped with the multiple integrated laser engagement system (MILES), which is used to simulate kills and casualties.

The regiment has access to a total of 50 drones, each with a maximum flight time of 28 minutes and capable of carrying a 3.6 kg payload. They have been in use in the reconnaissance role since 2019, according to

a February 2020 article published by High Desert Warrior, a civilian newspaper that is an authorised publication for the staff and families at Fort Irwin where the NTC is based. However, this is thought to be the first indication of how they are used as a swarm.

The 11th ACR is the NTC's professional opposition force (OPFOR), trained to mimic the capabilities of potential opponent's such as the Russian or Chinese armed forces. The initiative is known as the Blackhorse Drone Training Programme, and it is designed to provide units visiting the NTC with live experience of drone tactics, techniques, and procedures (TTPs) that an enemy might use in combat.

"Drones will be as important in the first battle of the next war as artillery is today," Brig Gen Taylor said in his tweet. The development is driven by the NTC's mission to replicate emerging trends in the character of war.

It is clear from multiple conflicts; The Libyan Civil War, the wars against Daesh in Iraq and Syria, attacks launched by Yemen's Houthis against Saudi Arabia, the war between Armenia and Azerbaijan, and of course Ukraine, that drones are a permanent fixture of modern conflicts. Their proliferation has mutated the character of war, with the result that tactical and operational surprise can be difficult to achieve. Consider, for example, the Russian attempt to cross the Siverskyi Donets River in May 2022, which was discovered through a combination of drones and on-the-ground reconnaissance leading to the loss of around a battalion of equipment.

Ample footage from the Armenian-Azeri conflict over Nagorno-Karabakh further emphasises that infantry formations and armour can be easily detected and that drone-based intelligence, surveillance, and reconnaissance (ISR) can provide persistent surveillance of a position unnoticed. Typically, these conflicts have included the integration of the ISR asset into a targeting cycle, combining artillery or loitering munitions with the strike capabilities of the drones themselves to cause heavy attrition.

However, other conflicts, such as the counter-insurgency campaign in Mali, or the Syrian civil war, show that swarms of small drones are regularly used to carry small mu-

nitions onto a target. In the case of the campaign to defeat Daesh in Mosul, they were used to coordinate company-level attacks and conduct mortar strikes against Iraqi command posts.

It follows that armed forces can therefore expect to face drones regardless of whether they are engaging a peer opponent such as Russia, or a mid-tier opponent with access and funds for military and even commercial drones, or a sub-peer, non-state opponent. In each scenario they might present a different level of risk.

In situations where the opponent is able to coordinate real-time ISR feeds with indirect fire assets, the results can be catastrophic, as both Russia and Ukraine have demonstrated. In others, the use of small drones can rapidly elevate the costs of a deployment. A noteworthy example is the damage inflicted to Russia's Khmeimim airbase in Syria during 2018 by a swarm of drones armed with grenades.

Consequently, it is a necessity for forces to train against drones on a regular basis. The units that rotate through the NTC are given the hand-held DroneBuster gun, which jams the control signal of a drone, either bringing it to the ground, or returning it to its last known waypoint. However, counter-drone tactics and training can and should include the use of decoys and camouflage to reduce certainty in gathered ISR. Ultimately, the defending force needs to ensure that the drone fails in its mission of gathering ISR or completing an engagement, this means that the use of kinetic force is not always necessary, but the skills to minimise a drone's success must be practised regularly and in scenarios that are as realistic as possible.

For many forces this represents a unique challenge. The US Army is fortunate in that it has access to very large areas of training real estate with relatively free reign over the airspace. For many European countries however, with a crowded airspace that must be deconflicted through civil aviation authorities ahead of any exercise, as well as restrictive training safety regulations, it may prove very challenging to integrate drones of any size into a combined arms training exercise, let alone practise the electronic warfare capabilities needed to jam a drone or degrade its sensor suite.

Author

Sam Cranny-Evans is a research analyst focusing on Russia, China, and C4ISR at the Royal United Services Institute (RUSI) in London. He joined RUSI in 2021 after five years at Jane's as editor and author of the Armoured Fighting Vehicles Yearbook.

Over the Horizon Sensing, Targeting, and Attack

Tamir Eshel

When nuclear-armed powers discuss strategic attacks, they often refer to the use of nuclear weapons. However, due to the extremely high costs of total war, such confrontations are luckily often avoided through diplomacy. Nevertheless, large conventional arms have been used in strategic attacks and have remained an important part of warfare since the introduction of nuclear weapons.

Such weapons have been obtained and sometimes used by armies in several conflicts since the 1980s. This article focuses on the offensive and defensive use of those conventional capabilities. Such weapons often take the form of ballistic or cruise missiles with powerful conventional warheads, and/or possessing very high precision guidance. These have the potential to cause massive devastation even without a nuclear warhead. These weapons are capable of crippling vital components of national infrastructure, such as energy, water, and food reserves or communications services. They can bring the economy to a standstill by targeting roadways, railways, and bridges, creating naval blockades, and damaging airport runways. Destroying naval and air defence assets, radars, and command posts is also part of such an offensive, as they protect those infrastructure.

Long-Range Attack

Long-range attacks have always been considered a capability that has the potential to deal a strategic effect on an enemy. Striking deep inside the country's rear area, an enemy would target critical military and industrial infrastructure. As most such infrastructure is fixed, these targets are often struck by ballistic or cruise missiles, guided to their targets by inertial (INS) and satellite navigation (GNSS). Strategic targets are typically designated such because their destruction would have the potential to have a strategic impact on the war. That is why such targets are typically defended against enemy strikes to the greatest extent possible.

Relocatable targets also considered strategic assets are mobile ballistic or cruise missile launchers, long-range air defence or anti-ballistic missile (ABM) systems, larger classes of ships, submarines, field-



Photo: Lockheed Martin

The AGM-183 ARRW (Air-Launched Rapid Response Weapon) is a hypersonic weapon planned for use by the United States Air Force. Developed by Lockheed Martin, the boost glide weapon is propelled to a maximum speed of more than Mach 5 by a rocket motor before gliding towards its target.

deployable command posts. These would typically be classed as 'short-lived targets', since location could quickly change from the time a target is detected to the time when an attack is launched. Such strikes rely on short 'sensor to shooter' cycles and would require a high level of flexibility in target acquisition and communications, to rapidly launch the appropriate munition at the target, and enabling the operators to upload target updates during the flight.

In the past, deep strikes required an attack force to fly into the enemy's rear area, risking significant losses to enemy air defence. In the modern age, ballistic and cruise missiles are used for some

strategic attacks. The Russian War in Ukraine is demonstrating the use of such capabilities, with Moscow using ballistic and cruise missiles fired from distances of hundreds, or even thousands of kilometres, to hit strategic targets deep inside Ukraine.

Intelligence Prelude

Launched over the horizon, deep strikes require extensive preparations. Determining which targets should be hit, the level of destruction required, and how best to achieve the right effects all require planning. At this preparatory phase, the combined use of different in-

Photo: Russian MoD / Vadim Savitskiy



The Russian forces that invaded Ukraine in February 2022 used 9M723 ISKANDER-M short-range ballistic missiles, and 9M728 ISKANDER-K cruise missiles, deployed from ground-based launchers.

telligence sources is critical. For static or semi-mobile targets, satellite imagery would be the first choice, but satellites rarely provide intelligence with near-real-time value due to their limited revisit frequency and dependence on weather and cloud coverage. When continuous surveillance of targets is needed, smaller satellites with higher revisit rates can be used. These fly at lower orbits and provide lower resolutions, but utilizing constellations of dozens of satellites, they can keep targets of interest in near-continuous view.

More accurate data is often required for the designation of a target for precision effects. Such information could be obtained by stand-in airborne surveillance, using either optical sensors or Synthetic Aperture Radar (SAR), which would allow real-time assessment of the target surroundings. These can be coupled with human intelligence (HUMINT) operatives on-site, or forward observers, thus enabling the shooter to optimise effect and avoid unintended damage and casualties. Battle Damage Assessment (BDA) is also an important capability, as it provides the planners the ability to assess the damage caused by each strike and engage the target again in case of a miss, malfunction, or in pursuit of fleeting targets in its vicinity. Stealthy aircraft such as the F-35 LIGHTNING II Joint Strike Fighter (JSF) aircraft are useful assets for targeting long-range strikes, with this capability having been demonstrated in several joint forces exercises, where the JSF provided targeting information for stand-off attacks, in addition to its own inherent capability to carry out strikes.

In our review, we regard long-range strikes as the capability to attack beyond the horizon. But the horizon is a relative term – for an average human at sea level, the distance to the horizon is approximately 4.8 km, but for aerial platforms at high altitudes, the horizon spans can span for hundreds of kilometres. Attacks ‘beyond the horizon’ usually refer to strikes at ranges of 100 km or more, where weapons would require propulsion, communications for mid-course updates or parameter modifications, as well as navigation, and terminal guidance systems.

Deep Strike with Air-Launched Weapons

Deep strikes are often conducted by assets operated in multi-domain operations. Land, sea, or submarine-launched weapons are designed to reach their targets using their own propulsion. These largely fall into the categories of air-breathing engines for cruise missiles or solid propellant for ballistic missiles. Modern missiles are designed to hit their targets from hundreds of kilometres, within a few meters of the targeted point. In the War between Azerbaijan and Armenia ballistic missile attacks were launched over ranges beyond 100 kilometres in conjunction with loitering munitions. The Russian forces that invaded Ukraine in February 2022 used 9M723 ISKANDER-M short-range ballistic missiles, and 9M728 ISKANDER-K cruise missiles, deployed from ground-based launchers. These were supplemented by ship- and submarine-launched KALIBR

family cruise missiles. Russia also used hypersonic air-launched missiles (Kh-57M2 KINZHAL) to attack targets as far as Kyiv and Lviv, hundreds of kilometres away. It is assumed that the targeting of such weapons relied primarily on satellite imagery since most of the targets attacked were fixed infrastructure, not mobile or relocatable targets.

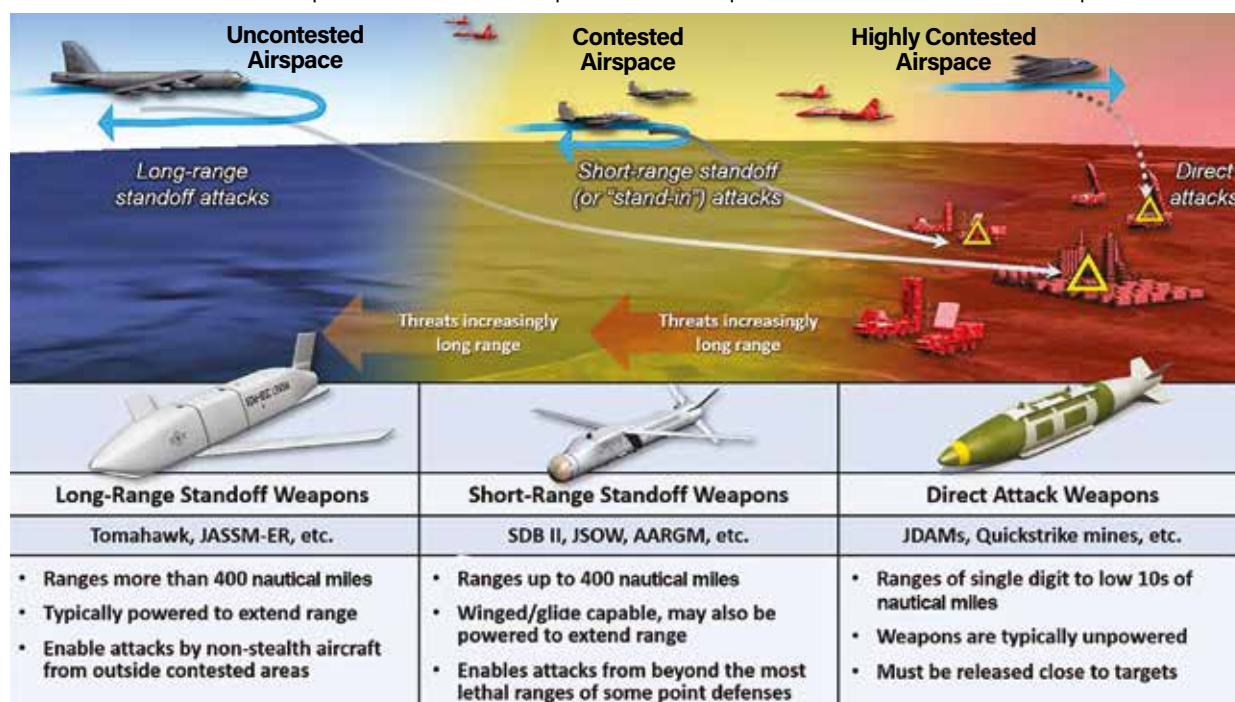
When air-launched missiles are used, planners can rely upon the launching aircraft to provide part of the energy for the missile’s flight, providing increased range compared to the same weapon being launched from the ground or sea. This effect can be exploited to develop air-launched standoff weapons which are lighter than their ground- or sea-launched counterparts. Examples include the AGM-158 Joint Air-To Surface Stand-off Missile (JASSM), and the Russian KH-101/102 cruise missiles. This property also allows existing air-launched weapons to be modified for greater range fairly easily. An example of such modification is the Powered Joint Direct Attack Launched Munition (JDAM) recently introduced by the Boeing company. Boeing suggests adding a small turbojet engine to convert the JDAM into a long-range and versatile payload-carrying platform that will be able to carry weapons or other payloads over a long range. With a range of 1,296 km (700 nautical miles), the Powered JDAM will be able to carry out missions originally designed for JASSM cruise missiles or ADM-160 Miniature Air-Launched Decoy (MALD) at a tenth of the cost of the alternative. Naval cruise missiles also included in this category are the Tomahawk family, and its Russian equivalent, the Kalibr family of missiles.

Other air-launched weapons consist of semi-ballistic missiles such as the RAMPAGE, produced by IAI and Elbit Systems, and Rafael’s ROCKS. Both are used in long-range strikes. The RAMPAGE uses GPS guidance to hit stationary targets at long distances. ROCKS can employ either Rafael’s scene matching or anti-radiation homing guidance. The former uses artificial intelligence and optics to match a target scene to imagery obtained by other means, such as satellite imagery, intelligence sources, and is combined with automatic target recognition. This is the same guidance techniques used by Rafael’s SPICE family guidance kits.

Missile attack is not reserved only for combat aircraft. Using multiple missiles against highly defended targets, will soon be enabled by the US Air Force’s ‘Rapid Dragon’ or ‘arsenal plane’ con-

Range of Options

The closer attacking aircraft get to their targets, the greater the threat from integrated air defense systems. Only stealth aircraft can penetrate those defenses to deliver unpowered direct-attack weapons. Standoff weapons extend the reach of conventional platforms.



cept, using pallets carrying either six or nine (depending on aircraft size) cruise missiles, which carried and released from the rear doors of a transport aircraft. This system has so far been tested with AGM-158B JASSM-ER cruise missiles, and when completed will permit launching coordinated multiple cruise missile strikes against targets approximately 1,000 km away. This would enable several transport aircraft to deploy levels of firepower comparable to destroyers and submarines. Multiple pallets of missiles could be deployed from each aircraft, resulting in swarm-like coordinated strikes by low-observable cruise missiles, giving minimal warning to the enemy.

Guided cruise missiles are often used in standoff attacks against air defence and airfields hosting fighter aircraft. As the precision of such weapons improves, the size of their warheads can be reduced while increasing their range and lethality by design optimisation. These effects can be further optimised through warhead selection, and to avoid collateral damage, warhead size and effect should be matched to the target type and guidance accuracy.

Artillery, rockets, and missiles are also becoming effective tools for deep attacks. Current precision rocket artillery can already exceed ranges of 70-90 km, and these weapons would soon deliver

ramjet-propelled rounds reaching as far as 150 km. Missiles, such as the Lockheed Martin's Precision Strike Missile (PRSM) will enable the existing M270 Multiple Launch Rocket System (MLRS) and M142 High Mobility Artillery Rocket System (HIMARS) to hit targets at 499 km with high precision. To attack farther than that, Russian, Chinese, and, most recently also the US, plan to employ hypersonic glide vehicles launched from air, ground, and naval platforms to strike targets at ranges beyond 1,500 km, leveraging the weapons' high speed to avoid enemy defences. The effective use of such weapons requires real-time targeting information obtained from sensors such as Unmanned Aerial Vehicles (UAV) or satellite imagery. These characteristics enable missile and artillery fire to become an effective player in deep strike multi-domain operations. Artillery duels in East Ukraine have demonstrated the need for such long-range effects with modern artillery fires.

The Offensive Potential of Loitering Munitions

Optimised warheads are also used with loitering munitions to engage 'short-lived' targets at long distances. Due to their long-range and endurance characteristics, loitering munitions are used for intelligence gathering, target acqui-

sition, and strikes without relying on external sources. These capabilities are a good enabling factor, because they allow engaging targets with minimal support. Employing passive RF seekers for air defence suppression and optical-based automatic target recognition, loitering munitions such as IAI's MINI HARPY possess multiple means to detect, identify and track targets. Such loitering weapons can establish effective persistent surveillance deep into enemy territory. Once targets appear, the loitering munitions can quickly detect, locate, and engage such targets of opportunity, with very short sensor-to-shooter cycles.

Deep Strikes Leverage National Defence

Modern technology provides states the power to strike deep into enemy territory and engage strategic targets with a high probability of success, and establish a credible threat over an adversary, maintaining a level of deterrence that could prevent a hostile attack. In the past, maintaining such capabilities required investments in air power and skills beyond the reach of most states. Today, strategic strikes by conventional weapons have become a reality, even for small armies committed to defending the state against external threats. ■

Thunderstruck! – Hanwha Unveils K9A2 SPH Prototype

Mark Cazalet

On 21 September 2022, Hanwha Defence unveiled a prototype version of their developmental K9A2 Self-Propelled Howitzer (SPH) for the first time at the DVD 2022 defence exhibition at Millbrook Proving Ground, in the UK. The vehicle was presented as part of the company's bid for the UK's Mobile Fires Platform (MFP) future artillery programme.

The K9A2 is the latest variant of the K9 THUNDER tracked SPH family developed by Hanwha, and represents a major upgrade over the earlier K9 and K9A1 variants. The vehicle features improvements to fire rate, automation, crewing, and quality of life changes for the crew. The vehicle also provides a capability growth option for its existing userbase, with Hanwha stating

that any earlier variant in the family could be upgraded to the K9A2 standard. South Korea has already mandated that 50% of their K9 platforms would be upgraded to K9A2 following the completion of its development, in a programme which has already been fully funded. According to Hanwha's timetable development of the K9A2 is due to be completed in 2025, with deliveries to the South Korean Army to start in 2026 or 2027.

New Thunder, New Capabilities

In terms of armament, the K9A2 retains the 155 mm/L52 gun used by earlier family variants, providing a representative maximum range of approximately 50 km with rocket-assisted projectile (RAP) rounds, though this could potentially be greater depending on the ammunition nature used. The gun supports NATO Joint Ballistics Memorandum of Understanding (JBMoU)-compliant 155 mm projectiles with a 23 litre combustion chamber volume, and has been successfully tested with various guided projectiles including the EXCALIBUR GPS guided round. A representative stated that some users had also expressed an interest in operating their K9 SPHs with Leonardo VULCANO Guided Long-Range (GLR) sub-calibre guided projectiles using the semi-active laser (SAL) guidance option. According to Leonardo, this would enable fire missions out to 70 km, with a circular error probable (CEP) of ≤ 3 m. In addition to the aforementioned natures, some K9 user nations are in the process of qualifying Northrop Grumman's Precision Guidance Kit (PGK) for their K9s. This is a fuze kit which allows a user to convert unguided rounds to GPS-guided rounds by swapping the fuze for the PGK and using an ammunition programmer to input the projectile's target coordinates.

The K9A2's turret is electrically driven with manual backup for emergencies, providing traverse through 360° and the gun's depression and elevation range is from -2.5° to +70°. As with earlier variants of the K9 family, the digital fire control system is highly automated and can be linked to external command-and-control (C2) assets, permitting automatic gun laying onto targets located by friendly reconnaissance assets and distributed over the C2 network. This assists the crew in conducting rapid fire missions in shoot-and-scoot scenarios, since targets can be pre-assigned.

Despite many similarities, the turret has seen substantial modification compared to earlier K9 variants, both internally and externally. Perhaps the most notable new feature of the K9A2 is its rather innovative automatic ammunition handling and loading system, which permits reloading at any turret traverse position or gun elevation. The earlier K9 and K9A1 relied instead upon a semi-automatic loading system, in which the rounds were loaded automatically, while the charges were loaded manually. As a result, the K9A2 is capable of attaining a fire rate of at least 9 rds/min, compared to the K9 and K9A1's maximum of 6 rds/min. This has also allowed Hanwha to reduce the vehicle's crewing requirements, from five crew on earlier variants, to three on K9A2.

The K9A2's loading system operates using a projectile conveyor, drop-down stacked propellant racks, a sliding tray, and a breech-mounted feed tray. In operation, the projectile and charge(s) are loaded onto a sliding tray, positioned side-by-side before being pushed onto the feed tray. The feed tray is then aligned with the elevation of the gun breech, and a rammer pushes the projectile, followed shortly after by the charge(s) into the chamber. The feed tray then swings upwards, out of the way of the recoiling mass of the gun, and the system is ready to fire. This entire process takes



Photos: Mark Cazalet

Hanwha's K9A2 THUNDER prototype on public display for the first time at the DVD 2022 exhibition in Millbrook, UK.

an approximate average of 7.45 seconds, although the process could potentially be faster or slower, depending on various factors, such as the position of the next selected round in the conveyor. In this vein, a Hanwha representative stated that there were two versions of the autoloader in the works, with the 'V1' version capable of attaining a maximum fire rate of 9 rds/min (6.66 sec per round), and a 'V2' version capable of attaining maximum a fire rate of 10 rds/min (6 sec per round).

To accommodate the ammunition handling system, the turret has been modified, with the bustle lengthened and most of the turret's roofline raised compared to the earlier K9A1. These changes have provided space to move all 48 rounds and 240 propellant charges into the turret, an improvement on previous variants, which required some of the charges to be kept on the hull floor due to space constraints. A Hanwha representative explained that the reason for the high number of charges was the Korean Army's requirement was for each round carried to have a possible five charge load (the maximum is six), to ensure sufficient charge supply for most foreseeable fire mission types (hence $5 \times 48 = 240$ charges). Due to this turret redesign, the auxiliary power unit (APU) first implemented on K9A1 has also had to be relocated, from its position on the rear-left of the turret, to an internal position in the rear-right of the hull. Additional changes planned for the production version of the vehicle, but not seen on the prototype include the integration of a remote weapon station (RWS) for self-protection at short ranges, and an air conditioning system for the crew. Hanwha company representatives stated that the prototype vehicle shown was the exact vehicle being used for development trials in South Korea, and was shipped over to the UK for the exhibition. While many features on the vehicle would be representative of the final design, there were also a number of key differences between prototype and the likely final vehicle. For one, the prototype vehicle only had seats for two crew, a driver and a gunner, with the latter seated in rear-right of the hull, behind the turret. A Hanwha representative explained that the final design would use three crew, a driver, gunner, and commander, and the latter two crew would be seated in a turret basket, with commander located on the left side of the gun and the gunner located on the right side. Both would be provided with the same multi-functional display and common controls. A further difference was that the autofret-tagged barrel used on the prototype did not feature a chrome lining, a feature which company representatives stated was not

being used for trials, but was planned for inclusion in the production version.

In terms of protection, the vehicle hull has an all-round protection rating of STANAG 4569 Level 3, while the turret was understood to be approximately STANAG 4569 Level 1. Hanwha representatives stated that the platform had additional growth potential for 3 tonnes of weight, allowing some further protection to be added if required. However, realistically for most users this option would probably only be exercised to add mine protection, since by virtue of its role the vehicle is not intended for front line combat, and 3 tonnes would only provide room for very marginal improvements to passive ballistic protection. The platform is equipped with a 745.7 kW (1,000 hp) engine, providing 15.86 kW/tonne (21.27 hp/tonne) when equipped with CRTs, and a hydro-pneumatic suspension system, enabling variable ground clearance.

K9 and MFP

If selected for the UK's Mobile Fires Platform (MFP) programme, Hanwha is offering to produce the UK variant of K9A2 using >50% of local content, and has put together 'Team Thunder', a collection of UK-based industries, to help the UK deliver this capability domestically. The members of Team Thunder and their roles comprise:

- Hanwha Defense – Prime contractor and design authority.
- Lockheed Martin UK (Amphill facility) – Turret production, platform and systems integration, and trials.
- Pearson Engineering (Newcastle facility) – Hull fabrication and manufacturing, integration.
- Leonardo UK (Edinburgh facility) – Production of on-board navigation and pointing systems.



Three-quarter view of the K9A2 prototype, note that the prototype is being trialled using conventional steel tracks.



Side view of the K9A2 prototype, showing the lengthened bustle, and the raised roofline to accommodate the new automatic loading system and all charges.

- Soucy Defense (Devon facility) – Production of Composite Rubber Tracks (CRTs).
- Horstman (Bath Facility) – Production of hydro-pneumatic suspension units and other running gear components.

It is noteworthy that Team Thunder announced their intention at the outset to offer the K9A2 to the UK with Soucy composite rubber tracks (CRTs). The tracks dampen vibration and decrease the acoustic signature of the vehicle, as well as decreasing its weight, from 49 tonnes with conventional steel tracks, to 47 tonnes with CRTs. A Soucy representative stated that the company's tracks were typically tailored to a specific platform, and a 47 tonne weight target could be met. Additionally, he noted that Soucy was already in the process of developing CRTs with a 55 tonne weight limit, but did not provide a definitive timescale for the completion of this effort. In terms of meeting transportability requirements, Hanwha representatives stated that due to its size and weight, the K9A2 could only be transported by C-17 or larger aircraft, and is therefore incapable of being transported via A400M. While this may be potentially problematic, to various degrees the same problem is likely to apply to a few of the K9A2's competi-

tors for the MPF programme, albeit not all of them. On the tactical mobility side, as the one of the very few tracked options for the MFP programme, the K9A2 would be expected to outperform its wheeled competition in terms of terrain trafficability, soft soil mobility, and hill climbing. These tractive advantages would also carry over to the accompanying K10 autonomous ammunition resupply vehicle, which operates alongside the K9, and can automatically resupply the SPH with ammunition at a rate of 10 rds/min.

While Team Thunder's offer presents a number of compelling positives, and represents an upgraded form of continuity for the UK's existing tracked artillery fleet, much is dependent on how the British Army will decide to weight its various requirements.

Future Development

Further down the line, Hanwha plans to build on the K9 family's level of automation in their development roadmap, which plans for a K9A3 variant to complete development in the 2030s. The K9A3 is set to feature a 155 mm/L58 gun, increasing the effective range for standard shells by

approximately 10 km. The vehicle is also due to be provided with improved automation capabilities, enabling fully automated operation, including autonomous driving. Under Hanwha's roadmap, this is due to be completed in the 2030s.

Beyond this, Hanwha plans to build a fully robotised variant of the K9, with manned-unmanned teaming capabilities. At present, this variant is only known under the working designation 'K9 Next Generation'. The envisaged setup involves a single manned SPH teamed with two unmanned SPHs, thereby enabling a battery of six SPHs consisting of two manned and four unmanned vehicles. This is of particular interest when considering falling recruitment among many developed countries for demographic or comparative reasons. Under present company plans, this variant is slated for completing development in the 2040s.

The K9 family therefore appears set for a long developmental life, with a growing userbase, upgrade path, and plans for integration of various new or experimental technologies over time. It will be interesting to see how these planned changes will turn out, but based on current trends the K9 family's future looks promising. ■

India's Light Tank Programme, a Mountain to Climb

Sam Cranny-Evans

India is to move ahead with the ambitious domestic development of a light tank capable of fighting in the mountainous Ladakh region that borders China, the New Indian Express reported on 20 September 2022, citing "sources in the security establishment."

Author

Sam Cranny-Evans is a research analyst focusing on Russia, China, and C4ISR at the Royal United Services Institute (RUSI) in London. He joined RUSI in 2021 after five years at Jane's as editor and author of the Armoured Fighting Vehicles Yearbook.

It is understood that a prototype of the first vehicle is to be produced by the end of 2023 as a result of collaboration between the company Larsen and Toubro (L&T) and India's Defence Research and Development Organisation (DRDO). Hanwha had also expressed interest in the programme, offering its 105 mm armed K21-105 in a potential production deal with L&T in 2021. Once the prototype has completed extensive trials, it will progress to tender and is expected to be built in India, which would require some form of technology transfer if a foreign manufacturer is involved. The tank is to be known as 'Zorawar' after Indian general Zorawar Singh Kahluria, who is credited with conquering the Ladakh region in 1835. The Indian

MoD released an ambitious request for information (RFI) in 2021, approval for which was granted shortly after the 2020 stand-off with China in the Ladakh region.

The RFI was extensive, and indicated an interest in procurement of 350 domestically-manufactured vehicles with good mobility on most terrains, capable of operating at high altitudes, carrying multiple forms of protection including explosive reactive armour (ERA), an active protection system (APS), and signature management solutions. The RFI also indicated that the vehicle should be capable of launching missiles, carry a large calibre gun, weigh no more than 25 tonnes and include the ability to engage UAVs. The New Indian Express'

source added that the design is expected to include artificial intelligence (AI) and unmanned aerial vehicle (UAV) integration. Despite recent progress, it is far from certain that the programme will reach a successful conclusion. A very similar RFI was issued by the Indian MoD in 2009, which covered wheeled and tracked vehicles for use at high altitudes and in a reconnaissance role as part of India's 'Cold Start'

The requirements for the Zorawar are also ambitious. At high altitudes, internal combustion engines lose power - around 3% for every 305 m (1,000 ft) of elevation due to oxygen density decreasing with altitude. This means that the 581.6 kW (780 hp) engine of India's basic T-72, would produce approximately 494.4 kW (663 hp) at the highest point in the Ladakh region, whereas the 745.7

its weight, as would an ERA suite. Such solutions would all likely come at the expense of its mobility unless a more powerful powerpack were to be used. This would likely increase the vehicle's weight yet again, leading to another weight-mobility spiral.

Of course, the RFI is not definitive, and it is possible that the Indian Army will revise its requirements to procure a vehicle that



Photo: Rik111, via Wikimedia Commons

India is moving ahead once again with an ambitious project to develop and procure a light tank for use in its inhospitable Ladakh region

strategy. The RFI was driven by an increase in tensions with China at the time, industry press reported. India has had extensive success introducing locally-manufactured T-90S main battle tanks (MBTs) and BMP-2 infantry fighting vehicles (IFVs) into service, and the first licence-produced K9 Vajra self-propelled howitzer (SPH) was displayed by L&T in 2020.

However, those projects that have been developed from scratch in India have often met with significant resistance. The Arjun MBT is the most notorious example of a troubled development programme, but it is not alone. India's domestic INSAS assault rifle became one of the primary rifles of Indian forces from 1998 after a protracted and delayed development process. Its performance in the 1999 Kargil war was lacklustre, and the Indian Army was driven to search for a replacement, which it found in the AK-203. Additionally, the country's attempts to modernise its fleet of T-72M1s have been ongoing since the 1980s without reaching a successful conclusion, leading to reports that large portions of the fleet are inoperable.

kW (1,000 hp) engine of India's T-90S fleet would be reduced to 633.8 kW (850 hp). This in turn leads to a reduction in power-to-weight ratios, as well as a loss of mobility and manoeuvrability. For comparison, China's light tank, the ZTQ-15, is powered by a 745.7 kW (1,000 hp) engine at a maximum vehicle weight of 30 tonnes. For the vehicle to be capable of navigating the Ladakh region and providing greater mobility than India's existing tank fleet, it will need a suitably powerful and robust engine.

There is also the matter of survivability at the stated weight, which is likely to be an immovable requirement for the programme, if it is to meet its mobility requirements. The K21-105 for example, weighs 25 tonnes according to Hanwha. It would theoretically be capable of meeting the mobility requirements with its 559.3 kW (750 hp) engine, however its armour is unlikely to be designed to resist much more than 30 mm cannon rounds across the frontal arc. The addition of an APS to increase this level of protection - especially against anti-tank missiles, but would increase

will enable it to match the capabilities of the ZTQ-15 and provide overmatch against insurgents in the Kashmir region, as well as the light infantry that China uses for operations in its mountainous regions. This could be achieved within the stated capabilities of the K21-105, the PT Pindad and FNSS Harimau, and Russia's Sprut-SDM1. However, regarding the latter option, India might now be wary of further procurements from the Russian defence industry, which are likely to be hampered by international sanctions.

If the prototype developed by the DRDO and L&T is a new-build design, it will face a veritable mountain of development challenges. The average development time frame of a tracked armoured vehicle is around 15 years, and is often far from straightforward, as the UK's Ajax procurement programme shows. However, a product developed from an existing base platform could be entered into service in a much shorter time frame. The procurement and production of the K9 Vajra is testament to this - the process took just six years from contract approval in 2015, to delivery of the 100th vehicle in 2021. ■



Viewpoint from New Delhi



Photo: Suman Sharma

Indian Air Force Sacks Three Officers for Accidentally Launching BrahMos Missile into Pakistan

Suman Sharma

Under disciplinary action taken by the Indian Air Force (IAF), three senior officers found responsible for the 9 March 2022 accidental launch of a BrahMos missile, have been sacked on 23 August 2022. The incident took place during a "routine maintenance and inspection" drill, in which the missile was accidentally launched from the IAF's BrahMos missile unit in Sirsa near Ambala. The missile then flew for over 250 km, landing by the town of Mian Channu, in Pakistan Punjab's Khanewal district, over 120 km West of the India-Pakistan border.

The IAF issued a statement on the incident, stating that the "BrahMos missile was accidentally fired on 09 March 2022. A Court of Inquiry (Col), set up to establish the facts of the case, including fixing responsibility for the incident, found that deviation from the Standard Operating Procedures (SOP) by three officers led to the accidental firing of the missile."

Islamabad, however, rejected India's action terming it "inadequate" and "unsatisfactory". Reiterating its earlier demand of a joint probe, in its official statement, Pakistan's Foreign Office said, "As expected, the measures taken by India in the aftermath of the incident and the subsequent findings and punishments handed by the so-called internal Col are totally unsatisfactory, deficient and inadequate."

The unfortunate incident, which was a first of its kind in the IAF, was made more so by the fact that the BrahMos is nuclear-capable, although in this case it was thankfully unarmed. The Ambala base it was launched from falls under the operational command of the IAF's Delhi-based Western Air Command, which is largely focussed on Pakistan. The incident sparked a debate on whether it was accidental or intentional, regarding which the IAF's Air Marshal (retd.) B. Suresh stated, "I can't recall any such incident in the past. This could not have been a deliberate action. Nobody in their right mind would do it."

Following the 9 March incident, Pakistan registered a strong protest against India, citing specifics detailed by the Pakistani military, that the Indian missile flew for 3 minutes and 46 seconds inside Pakistani airspace, thereby violating international law. This was followed by Indian Defence Minister Rajnath Singh's statement in Parliament promising a detailed inquiry

and attribution of accountability. The Pakistani Air Force was reported to have proposed "requisite tactical action" against India as per standard operating procedures (SOPs), but evidently decided against doing so. In a press briefing, Islamabad stated that its reason for not intercepting the incoming BrahMos was the absence of an ongoing war between both the nuclear-armed neighbours, who have fought three full-fledged wars with each other in the past 75 years.

In its March 2022 statement, the Indian Ministry of Defence (MoD) stated the cause of the accident was a "technical malfunction", adding, "While the incident is deeply regrettable, it is also a matter of relief that there has been no loss of life due to the accident." The more than five-month-long inquiry, headed by IAF's two-star Air Vice Marshal from Air Headquarters, concluded that it was human error which had caused the accidental launch. The ensuing disciplinary action resulted in the removal of the three senior officers of the rank of a Group Captain (the Commanding Officer of the missile unit), a Wing Commander and a Squadron Leader. Reportedly, a Senior Non Commissioned Officer (SNCO) from the IAF took action to thwart an even greater catastrophe after the missile's accidental launch.

There is a treaty in place, signed by India and Pakistan in 2005, according to which both countries have to inform each other about any ballistic missile tests and the flight path the missile is likely to take during the trial. The idea behind this agreement was to prevent mishaps and misunderstandings, to the environment safe and stable. The agreement also reiterates advance notification of at least three-days to be given to the other side before a flight test of a surface-to-surface land or sea-based ballistic missile. According to this agreement, test launch sites cannot be located within 40 km of the Line of Control (LoC) or the International Boundary (IB) between India and Pakistan, and the planned impact area cannot be within 75 km of the IB or LoC. The treaty further stresses that the flight path of the missile cannot cross the LoC or IB, and cannot come within 40 km of the border. Thankfully, on this occasion, the accidental violation of the treaty did not result in further escalation.



Norway's Security Environment and Role in NATO

Robert Czulda

Russian aggression against Ukraine has also influenced the security of Norway – Oslo has decided to increase short-term defence spending and boost rapid reaction capabilities, particularly in the High North. However, Norway does not report any increase to the Russian Northern Fleet, and so a long-term spending increase is rather unlikely.

Political-security alignments on the Scandinavian Peninsula are quite complex – all three states located in this area (Norway, Sweden, Finland) are close partners and friends. Since 1949 Norway has been a member state of NATO but is not in the European Union (it decided to stay outside in two referendums in 1972 and 1994). At the same time both Finland and Sweden are in the European Union (they both joined in 1995), but they remain outside NATO, though both recently applied to join. All three states belong to the EU's Schengen zone, while Norway is associated with the EU through its membership of the European Economic Area (EEA). Regional cooperation is one of Norway's strategic priorities. "Nordic cooperation is more important and stronger than ever" Norwegian Foreign Minister Anniken Huitfeldt said this June. Aside from bilateral ties, Nordic countries are also party to various intergovernmental fora as the Barents Euro-Arctic Council and the Arctic Council. There is also the Nordic Defence Cooperation (NORDEFCO), which includes Denmark, Finland, Iceland, Norway, and Sweden. It was established in 2009 and got a boost after the Russian annexation of the Crimean Peninsula in 2014. Its official goal is to "strengthen the participants' national defence, explore common synergies and facilitate efficient common solutions." In late-May 2022, Nordic defence ministers reiterated in a joint statement that this organisation is still considered



Photo: Helene Synes

Naval activities remain the most important element of Norway's security and foreign policy - no changes are expected



Photo: Alexander U. Fathi

P963 STEIL is the SKJOLD-class stealth missile corvette in service of the 1st Corvette Squadron

Author

Dr Robert Czulda specialises in International Affairs and Polish Defence matters and is based in Poland at the prestigious University of Łódź.



Photo: Alexander U. Fathi



F310 FRIDTJOF NANSEN was launched in 2006. A ship of that class, F313 HELGE INGSTAD was lost in 2018 after a collision with a tanker

relevant: “These regions constitute a single area of operations and coordinated or joint operational planning among the Nordic countries is therefore key”.

“Norwegian defence policy is based on three pillars” – Håkon Lunde Saxi (Associate Professor at the Norwegian Defence University College) explained during his interview with ESD – “these are: national capabilities, collective defence within NATO and bilateral relationships with key allies – the United States, the United Kingdom, Germany, France, and the Netherlands. The Nordic states are not explicitly mentioned, but they are extremely important as well.” Another interviewed expert, Paul Sigurd Hilde (Associate Professor at the Norwegian Institute for Defence Studies), added that “Norwegian defence spending as a percentage of GDP will go down this year and perhaps also next year. This is not a result of budgetary cuts, but rather due to a rapid growth of a Norwegian GDP. This is again much a result of higher prices of oil and gas.” During the last quarter of 2021 Norwegian oil and gas exports amounted to approximately EUR 10 billion per month. This was three times more than during the same period in 2020.

Norway versus Russia

All interviewed experts agree that Russia is Norway's greatest threat and challenge. Norway is one of five NATO members that now shares a land border with Russia. It is relatively short one (196 km), compared to Finland's 1,340-km frontier. It also has a maritime border in the Arctic Ocean and the Barents Sea. Norway faces the Kola Peninsula, which houses the Russian Northern Fleet. It is equipped with various

warships, including ICBM-armed nuclear submarines, and some Russian naval drills have been conducted partly in the Norwegian exclusive economic zone.

“A direct military threat from Russia has not increased, at least for now”, Per Erik Solli (Senior Defence Analyst at the Norwegian Institute of International Affairs) explained during an interview with ESD – “there is no change in their behaviour comparing to [the] pre-February 2022 period. We do not see an increased number of activities. Moreover, a lot of resources from the region [have] been deployed to Ukraine.” At least three landing ships from the Northern Fleet were deployed to the Black Sea. They transported troops from the 80th Independent Motor Rifle Brigade in Alakurtti and the 200th independent

Motorised Rifle Brigade in Pechenga. From a Norwegian point of view, it is crucial, that units belonging to the Northern Fleet have reportedly suffered heavy losses.

“In the 1990s many NATO member states lost any interest in Russia and did not see any challenges coming from this direction” – Saxi adds – “but even then, Norway had a different perception. Because we shared a border and Russia's Kola Peninsula remained heavily militarized, Oslo was concerned and did not significantly change its defence policy until the early 2000s. Nevertheless, in the early 2000s invasion defence was abandoned, largely due financial reasons, and there was a brief period in which ‘out-of-area’ operations became central. In this period, the thinking was that the risk of a Russian invasion was very low, although we did not rule out some limited security crisis involving Russia. That period ended around 2007. Norway then began to ask other NATO member states to focus more on the core tasks of the Alliance (collective defence). Since 2014, Norway has focused mainly on territorial and alliance collective defence”

The first wake-up call, which led to the deterioration of bilateral relations and Oslo's re-recognition of Russia as a significant threat, was Moscow's aggression against Georgia in 2008. The Russian invasion of Ukraine and its seizure of the Crimea Peninsula in 2014 further affected the Norwegian-Russian bilateral relations. Military cooperation was halted. In 2015, the Norwegian Chief of Defence explicitly recognized Russia as the main security challenge and advised to significantly increase defence spending. The final mo-

Photo: Norwegian Army



The Russian invasion of Ukraine and its seizure of the Crimea Peninsula in 2014 further affected the Norwegian-Russian bilateral relations. Military cooperation was halted



momentum that silenced any pro-Russian voices in Norway was the Kremlin's full aggression against Ukraine in early-2022. Prime Minister Jonas Gahr Støre said that this event "represents a turning point for Norwegian and European security" and as a result Norway has to boost its defence capabilities. EUR 310 million were devoted to increase military preparedness, particularly in the High North. "Any significant increase of spending is highly unlikely" – Hilde believes – "in Norway there is no general sense of any imminent threat to national security."

Norway maintains diplomatic relations with Russia, but bilateral cooperation was limited to selected areas, such as fisheries, border control or search and rescue (SAR). Also, there is still a direct hotline between the Joint Operations Headquarters in Norway and Russia's Northern Fleet. Foreign Minister Huitfeldt explained that Norway is keen to keep cooperation through the Arctic Council and via bilateral channels in order to "avoid misunderstandings in a tense situation" and to "maintain low tensions in the High North".

The High North

Norway, one of the members of the Arctic Five (alongside Canada, Denmark, Russia, the United States), puts a special emphasis on the High North, while other regions, such as the Baltic Sea, are of less importance (although it became more relevant after 2014 – Norway is involved in NATO's deterrence operation in Lithuania, three times participated in the Baltic Air Policing and regularly deploys vessels and personnel to NATO's standing minesweeper forces).

The High North is crucial for several reasons, not only from security and political angle, but also – or even foremostly – economic. Norway's fishery zones and major energy fields are located there. "50% of our export is oil and gas" – Saxi explained. Every year Oslo makes new oil and gas discoveries, which means the Norwegians expect to keep high production until at least 2030. Oslo plans to start drilling more in the north in less developed parts of the shelf, including in the Barents Sea and especially in the Wisting field, where 500 million barrels of oil equivalent were discovered. The plan for development and operation (PDO) is scheduled to be completed by the end of 2022.

Numerous articles were published in recent years about emerging threats inevitably impacting regional stability. Some voices have been alarming about Russia's militarisation of the Arctic, while others

highlighted climate change and new maritime routes, which would trigger armed rivalry and competition for resources. Russia's aggression against Ukraine potentially makes the High North even less secure, since – as put by now former Defence Minister Odd Roger Enoksen – "Russia has considerable security interests in the North and that affects Norway and NATO."

However, Hilde argues that this alarming narrative is mainly a result of a media hype and does not reflect actual developments. "This includes the US emphasis on countering China" – he said. Solli believes that "there are some speculations about Beijing's ambitions in the Arctic, but so

and another of their northern bases, Sør-Varanger, has now being equipped with FGM-148 JAVELIN ATGMs. In 2018 a new ranger company was established at Sør-Varanger, and is expected to become fully operational in 2025. The government will also assess how Norway could strengthen national capabilities such as drones, satellite-based services and other civil-military cooperation areas, and will assess suitable locations for this, including Andøya. The authors of a governmental paper, submitted to the parliament (Storting) in April this year have argued that Norway needs to boost its capabilities in the High North much further.



Photo: Kasper Kjølsvik

The High North is crucial for Norway for several reasons, not only from security and political angle, but also – or even foremostly – economic

far, we do not see any Chinese military activities in the region. Also, we are not even certain that they can operate in such rough weather conditions." This toned-down approach is shared by Rasmus Gjedssø Bertelsen (Professor of the University of Tromsø), who was quoted by 'High North News' in March this year. He does not believe that "what is currently going on in Ukraine will necessarily have a strong direct effect on the border relationship between Norway and Russia. Moscow wants to keep the High North and the Arctic separate from the conflict with the West in Ukraine and the Black Sea region." Most experts believe, however, that the High North could become an area of hostilities as a result of earlier escalation between Russia and NATO.

To counteract possible negative scenarios, Norway's Porsangermoen garrison will be reportedly boosted with artillery and an infrastructure upgrade,

Two air bases – Bodø and Andøya – were slated for a closure. "Both will still be closed in the sense that everyday Norwegian Air Force operation will cease" – Hilde explains – "however, Andøya - which will remain operational as long as the P-3C are still in service - will now be kept as a reserve base specially designated to receive allied aircraft during exercises, crises and war. The closure of Bodø (which is now basically complete, with the [Quick Reaction Alert] (QRA) [squadrons] having moved to Evenes) seems much less likely to be reversed, albeit as far as I know, there is still hope to keep some of the hardened shelters there". Bodø, Norway's main air base above Arctic Circle previously hosting F-16s, halted operations in January this year. A small detachment of SAR helicopters will remain at the base, and civilian operations will continue at Bodø Airport. Chief of the Norwegian Air Force General Rolf Folland also wants to keep Bodø,



Photo: Kasper Kjølsvik



Oslo has a very strict policy of not allowing permanent deployment of foreign troops on its soil during a peacetime

which was planned to be given to the civilian authorities.

Norway and NATO

Norway is a valuable member of NATO for at least three main reasons. First of all, Norway is an excellent destination for military training in harsh weather conditions. Secondly, Norway constitutes NATO's forward outpost in the Far North, also known as NATO's Northern Flank, and is crucial in monitoring Russian activities in the region. For instance, in October 2019, Norway detected ten Russian submarines heading to the Atlantic Ocean through the GIUK Gap (an area between Greenland and the United Kingdom). It was the largest Russian group of this type since the second half of the 1980s. In case of war Norway would have a vital role in securing northern transit lines between the United States and Europe. "Defence of Norway is also a defence of the Atlantic Ocean" – Hilde believes – "if any opponent seized Norway, it would be then able to operate its warships and aircraft from Norwegian bases. That could disrupt NATO's supply lines."

Thirdly, since 1981 Norway has been hosting stockpiles of US Marines' (USMC) weapons, ammunition, and other equipment. In this context it is worth mentioning that despite being one of NATO's founding nations in 1949, Oslo has a very strict policy of not allowing permanent deployment of foreign troops on its soil during peacetime. This is a piece of Cold War legacy, when Oslo was the only NATO member to share a land border with the Soviet Union. This policy, however, does

not mean that temporary deployments are also banned. Norway docks US nuclear submarines and hosts US B-1B strategic bombers. A few years ago, it accepted roughly 330 US Marines at Værnes, near Trondheim (though such moves have been objected to by the Kremlin and some Norwegian politicians).

In April 2021, the Supplementary Defence Cooperation Agreement (SDCA) was signed between Norway and the United States. It was ratified by the Norwegian parliament just before summer. Hilde explained that contrary to some media reports, "the agreement does not really open for the establishment of US bases in

Norway but [gives] the Americans a green light to build facilities within Norwegian bases and have special rights connected to these areas and infrastructure. There will be no permanent stationing of combat troops or aircraft (including the P-8 maritime patrol aircraft), though smaller detachments of logistics, communications or other support personnel might be stationed, more or less permanently".

The US forces are expected to erect some facilities in four Norwegian bases: Sola, Rygge, Evenes and Ramsund. "The air bases will function both as forward bases for P-8s, fighters and other aircraft (Andøya and Evenes), fighters (Rygge) and primarily air-to-air refueling aircraft (Sola) during exercises and peacetime deployments, and as reinforcement bases in crisis and war" – Hilde continues – "none of these represent something completely new. Andøya has long been used by [the] US Navy's P-8s and before that by P-3Cs. Similarly, the USAF's use of Sola is long standing. So basically, the new agreement is really a new, legal framework for long standing bilateral US-Norwegian cooperation".

Norway fully supports the Swedish and Finnish bids to join NATO. They all already cooperate closely, which is no wonder given they share the same threat perception and strategic interests. In 2020 defence ministers of these three states met in Porsangmoen (Norway) to sign a trilateral agreement regarding enhanced coordination of military operations in crisis and conflict. In 2021 Norway, Sweden and Denmark signed a further, similar agreement, which mentioned "areas of common concern" (Kattegat, Skagerrak,

Photo: Helene Synes



Norway constitutes NATO's forward outpost in the Far North, also known as NATO's Northern Flank, and is crucial in monitoring Russian activities in the region



the Baltic Sea, the North Sea, the Danish straits, and other surrounding areas).

The Swedish and Finnish forces took part in the Norwegian-led "Cold Response" exercises, which were held in northern Norway between early March and early April 2022. It involved roughly 35,000 soldiers from 28 states. Sweden participated with around 1,600 soldiers, while Finland contributed 700 soldiers. During the exercise, the Swedish and Finnish land forces trained as one joint brigade under the command of the Norwegian Army. Earlier, in 2019, during the Swedish "Northern Wind" exercises, Norway sent 4,500 troops to Sweden. Another example of cooperation is the Arctic Challenge Exercise (ACE), which the Nordic countries hold every two years. It has been hinted that joint air operations might be developed further into a joint airspace picture. Norway, Finland, and Sweden have now been working on allowing aircraft to land at each other's bases if needed in an emergency. "The more we stand together, the less likely it is that anyone will want to challenge any

of our nations, regardless of whether they are members of NATO or not" - Norway's Chief of Defence Eirik Kristoffersen said. Oslo hopes that their full membership will create a very effective platform for enhanced security dialogue and defence cooperation, which is already relatively mature between Sweden and Finland. "This is a massive game-changer for Norway" - Solli believes - "previously we are unable to cooperate on war plans. Now we will be able to do so. This means we could use their facilities, including railways. Moreover, any NATO reinforcement will now have more flexibility. If a situation is too risky in one place, they could now be deployed elsewhere."

"It will eliminate any strategic ambiguity" - Hilde adds - "as soon as they join, we will be able to assume that NATO and the United States would help them if they were attacked and that at the same time both Finland and Sweden would also contribute to a collective defence." Hilde predicts that "Norway's strategic position will significantly change. Moreover, there are

some important questions that must be addressed. For instance, which command they are going to choose? NATO has joint forces commands in Naples, Brunssum and Norfolk [Virginia]. Due to ongoing changes, they will have more geographical focus. Due to its maritime orientation, Norway openly expressed its wish to be attached to Norfolk. If Finland and Sweden choose a different command, then cooperation might be a little bit difficult." NORDEFCO will remain functional regardless of whether Finland and Sweden join NATO or not. Already in 2018, during the Norwegian chairmanship, NORDEFCO members agreed to cooperate not only in peacetime, but also during crisis or even conflict. In late-May the Nordic defence ministers announced that defence cooperation among those states is to be further strengthened through joint exercises, training, and visits. Moreover, Norway has pledged to assist Finland and Sweden with all necessary means if they were to be exposed to aggression prior to achieving NATO membership. ■

STURM

STORM



€ 39,90
ISBN 978-3-7822-1326-4
Order directly from us at
koehler-mittler-shop.de
or by telephone under
+49 (0)40 /70 70 80 322



Koehler

Maximilian Verlag GmbH & Co. KG | Stadthausbrücke 4 | 20099 Hamburg



Is the War in Ukraine Affecting Norway's Security Situation?

During the Cold War, Norway's northernmost county, Finnmark, was, along with Turkey, one of the only land areas in NATO that had a direct land border with the Soviet Union.

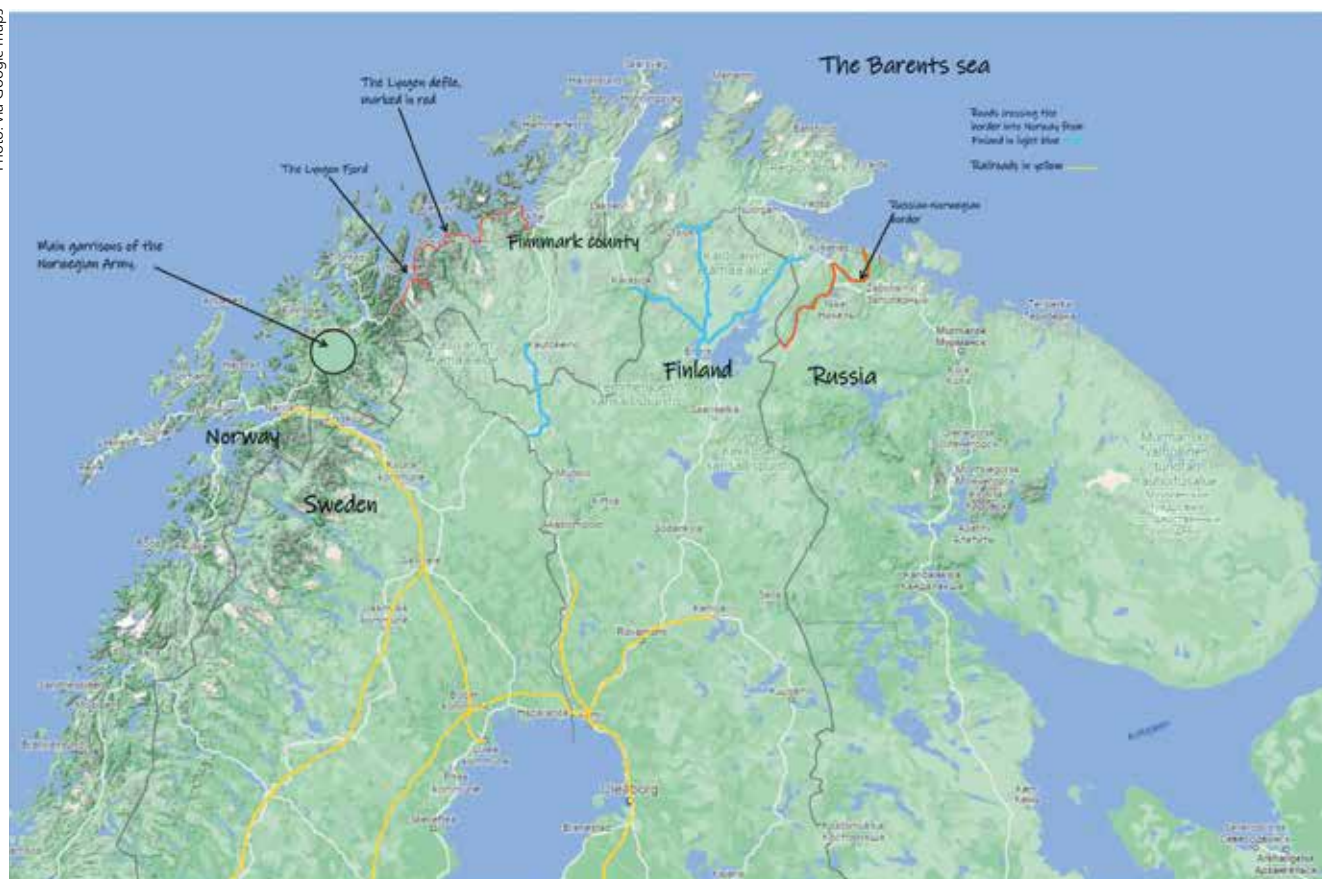
Björn Josefsen

The county of Finnmark stretches from West to East, all the way in the North of the Scandinavian peninsula, and at its easternmost point, where it borders Russia, is further east than St. Petersburg.

Finnmark is geographically the largest of the Norwegian counties, and the distance by road from its West to its East exceeds 500 km (315 miles). Topographically, the county is relatively flat compared to the

sula, where the home bases of the Russian Northern Fleet are located. This is one of the few areas in northern Russia where it is possible to establish harbours that can be kept ice-free in winter.

Photo: via Google maps



Many people are aware that Finnmark county lies far to the North, but the fact that the easternmost part of Finnmark lies farther East than St. Petersburg is perhaps more surprising. On the map, the critical Lyngen defile is marked in red, while the "new" roads into Finnmark through Finland and Sweden are marked in light blue.

Author

Bjørn Domaas Josefsen is Editor-in-Chief of the Scandinavian military magazine militærTeknikk.

other parts of Norway, and most of the county rises no more than 200 m above sea level. But since the county is so far to the north, the landscape is open and wide, with just a little low birch forest, and pine forest in some valleys. Immediately east of Finnmark lies the Russian Kola penin-

North of Finnmark lies the Barents Sea, an area rich in fish, oil, and gas. It is where the Russian Northern Fleet must sail to reach the Atlantic. This makes the Barents Sea a strategically very important area, not just for Norway, but also for NATO and indeed for Russia.



Norway's policy towards Russia in the North has always been based on Theodore Roosevelt's old aphorism "Speak softly and carry a big stick."

Throughout the years after the Second World War, Norway has worked to keep the tension in the North as low as possible. For one thing, as a self-imposed regulation, Norway has chosen not to host NATO bases on Norwegian soil, while also refraining from conducting major NATO exercises in or around Finnmark.

At the same time, Norway has put a lot of effort into keeping the best possible diplomatic relations with Russia, and even during the "coldest" periods during the Cold War, Norwegian and Russian fishery authorities managed to maintain a civil dialogue and agree on the distribution of fishing quotas in the Northern Sea areas.

But even though Norway has invested heavily in keeping tensions low in the North, and for more than 70 years has practised "speaking softly" towards the Soviet Union and later Russia, Norway has also "carried a big stick" in the form of her NATO membership. Throughout the Cold War, not least the Norwegian navy in the North was able to stand fast and act firmly without yielding to the far greater force of the Russian navy, in the knowledge that behind the Norwegian naval ships loomed both the American and British navies.

Finnmark is Difficult to Defend

From a military point of view, the Finnmark land area has always been difficult to defend. When the Nazi German army was on the retreat in the autumn of 1944, the German military leaders realized that Finnmark could not be defended against the Soviet army advancing from the east.

The German army then used the tactic of the "scorched earth" thus leaving Finnmark county deserted. The population was evacuated from all towns, and all forms of houses, wharfs, bridges, telephone poles and roads were either burnt down or destroyed.

The German army established a new defensive line in the fjord of Lyngen in North Troms, the so-called Lyngen Line. Here, the terrain is completely different from that in the major parts of Finnmark, with deep fjords and narrow valleys that almost split Norway in two. A defensive line in this terrain would be far easier to defend than a defensive line in the large and open landscapes of Finnmark further east. As it happened, however, the Soviet army chose not to advance into Norway, and the Second World War came to a close without any fighting on the Lyngen line.



Photo: Simon Amdal/ Norwegian Armed Forces

Norwegian soldiers training in Finnmark not far from the Russian border. In recent years, Norway has invested heavily in building up the Army in Finnmark. The picture also shows the wide-open landscape that is typical for large parts of Finnmark county.

But only a few years after the Second World War ended, the world was heading into the Cold War, where the Soviet Union was the main threat. It was not long before the Norwegian military and political authorities began to fear an invasion of Norway, across the Russian-Norwegian border in the east of Finnmark. And in the same manner as the German officers a few years earlier, the Norwegian military judged that standing up to the mighty Russian Army in the flat, open landscape of Finnmark would require far greater forces than what a small country such as Norway could muster. The Norwegian officers therefore came to the same conclusion as the German officers, that the Lyngen fjord is the first area towards the south of Finnmark where the terrain really favours the defence.

The Norwegian Army thus established its biggest garrisons in inner Troms, south of the Lyngen Fjord, and over the next 40 years, countless fortified positions were established in the steep mountain sides on the western side of the fjord, facing the fjord and the steep mountain sides on the east side. This was where any Russian invasion force through Finnmark was to be stopped.

In Cold War thinking, it was thought that an attack from the Soviet Union would involve an attempt to gain control of all or large parts of Western Europe, and in Norway this would mean that if the Soviet Army entered Finnmark, the objective would be to proceed South along the Norwegian coast.

But after the end of the Cold War, and with the recent Russian aggression, both

in Chechnya, Georgia and now in Ukraine, it is no longer a given that Finnmark will be only a small part of a larger conquest plan. Several military analyses have pointed to the possibility that Finnmark, or even only parts of Finnmark, could be the actual military target for a Russian invasion. Furthermore, the aim could be to occupy a smaller part of Finnmark, not to claim land, but to pressure the Norwegian authorities into political concessions. For example, the prerequisite for Russian withdrawal could be a demand to reduce Norwegian military presence in the North, or the removal of intelligence installations such as radars, or reinterpretation of the Svalbard Treaty to favour Russian interests in the archipelago, or a demand that Russia should control a greater share of the oil, gas, and fishery resources in the sea areas north of Finnmark.

The Lyngen Defile, a 70-year Headache for Norway's Military

The challenge for Norway is how to face such limited Russian military action on Norwegian soil. The Norwegian army has its most important fighting forces in the county of Troms, South of the old Lyngen line, and the natural response in a war-like situation would be to send forces North to face a Russian force in Finnmark. However, herein lies one of the big headaches for Norwegian defence, the so-called Lyngen defile, which stretches from the Lyngen fjord to Alta, in the West of Finnmark. A defile is a narrow gorge or passage in the terrain which, in a military context, restricts the access of forces. It is precisely



that impassable terrain North and East of the Lyngen fjord, which in its time would have been a narrow passage for a Soviet Army attacking Norway, will also be a narrow passage for any Norwegian forces that will come to Finnmark's aid. There is only a single road going from the Lyngen fjord to Alta. In many places the road is blasted out of sheer mountainsides, with a great number of bridges crossing rivers cascading down from the mountains. There are numerous points along road that can be easily destroyed with precision missiles, which would cause the road to be closed for weeks. Driving offroad to bypass a broken stretch of road is naturally not an option when the road sits precariously on a vertical mountainside.

What would of course be an option, would be to relocate the Army from Troms to Finnmark. But this would pose its own risks in the case that the Norwegian forces are unable to resist a Russian invasion force. In the worst-case scenario imaginable, the Norwegian forces would have to retreat to the Lyngen line, and if roads and bridges in the Lyngen defile were then destroyed, such a retreat would not be possible. In this worst case, Norway would lose its entire army in the north.

"The War in Ukraine Comes to Finnmark's rescue"

In recent years, there has been political agreement to strengthen the land defence of Finnmark. Among other measures, a light armour battalion has been formed, and the number of border forces has been increased. In addition, the Army of Finnmark has established extensive cooperation with the Home Guard, the Navy and the Air Force, and this spring the Chief of Finnmark's Land Defence stated his opinion that with today's combat forces it would be viable to defend Finnmark until allied forces were in place. This is nevertheless a controversial statement, and both political authorities and military leadership are in favour of a continued strengthening of the Army in Finnmark.

Meanwhile, and as a direct result of the War in Ukraine, Finland and Sweden are now applying for NATO membership. With Finland and Sweden in place as members of the alliance, the military situation for Finnmark will have changed completely. Where the Lyngen defile was the only land road into Finnmark, there are now four roads into Finnmark county that are opened from the south, through Sweden and Finland. These roads would not have been available to NATO forces as long as Sweden and Finland were neutral. In ad-

dition to the road network, both Sweden and Finland have a railway network that stretches northwards towards the Norwegian border in Finnmark, and which offers the opportunity to transport heavy material up to Norway by train, using the road network for only the last leg of the journey into Norway. The Swedish railway network in the North is also connected to the so-called Iron Ore railway, which is used to transport ore from the mines in the Swedish city of Kiruna, across the border for shipment from the Norwegian city of Narvik. The city has a well-developed, ice-free port which can also be very significant for the landing of allied forces for further transport with the Iron Ore railway into the North of Sweden, and further north along the road into



This map shows the dividing line in the sea North of Finnmark. The agreement on the dividing line was entered into in 2011, and involves, among other things, that Norway and Russia should cooperate on the development of any border-spanning oil and gas fields.

Finnmark. A third option could also be to ship reinforcements to the northernmost ports in the Gulf of Bothnia. From here, the remaining distance is about 400 km (250 miles) to Finnmark.

So, from being an isolated area with a border to Russia, and with the only access along a very vulnerable road, Finnmark will be far easier to defend as soon as Finnish and Swedish NATO membership is in place. And while it has been politically pointed out in Norway that Swedish and Finnish NATO membership will provide a basis for further defence cooperation between the Scandinavian nations, the biggest gain for

Norway lies in the fact that several possible supply lines into Finnmark will open up the moment Sweden and Finland become NATO members.

"Finland is an Island"

For the other Nordic countries, the strategic situation will change with NATO membership. Finnish military leaders have for many years described Finland's strategic location as an "island". To the East, Finland has a long border with Russia, to the North a border with the NATO member Norway, and to the South and West lies the Baltic Sea and the Gulf of Bothnia, on the other side of which lies neutral Sweden. This means that the only supply line from the West into Finland that does not pass through neutral Sweden or any NATO countries, is through the Baltic Sea. This is therefore a vulnerable supply line, especially in the winter when ship traffic to Finland passes through narrow waterways in the ice, opened by powerful icebreaker vessels.

But if both Finland and Sweden were to join NATO, the situation would be different. The Baltic Sea and the Gulf of Bothnia will effectively become an enclosed NATO sea body surrounded by Finland's NATO allies. In the North, Finland will have a land border with both allied Sweden and Norway. The opportunities for maintaining supply lines from the West to Finland will therefore be radically different.

Will the Russian Navy be Moving North?

Russia's Baltic fleet was established by Tsar Peter the Great, and during the Cold War the Baltic fleet comprised about 350 vessels, 16 of which were submarines. Today, the number of vessels has been significantly reduced, and according to open sources comprises approximately 42 surface vessels and one submarine, with bases in Kaliningrad and St. Petersburg. Even during NATO's eastward expansion, during which Poland, Lithuania, Latvia, and Estonia joining NATO as members, the value of Russia's Baltic fleet was much reduced compared to its former power.

With Finnish and Swedish NATO membership, the value of the Baltic fleet will be further diminished. The entry to St. Petersburg through the Gulf of Finland will lie between the NATO country Finland in the North and the NATO country Estonia in the South. The Kaliningrad enclave is today bordered on land by NATO members, Lithuania and Poland, and soon the rest of the countries around the Baltic Sea will also be NATO members.



The Russian Baltic fleet will therefore be almost worthless in a war where NATO is involved, and several analysts have stated that Russia will therefore be likely to invest more into strengthening its Northern Fleet, which has its bases on the Kola peninsula, East of Finnmark county.

Monitoring of the Barents Sea

Russia's bases on the Kola Peninsula are also home to the Northern Fleet's nuclear submarines, and during the Cold War Russia had more than 200 submarines (nuclear and conventional) stationed here.

and World War, and reports on Russian submarine movements in the Barents Sea have been among Norway's most important contributions to the NATO community. When Norway recently procured five new P-8A Poseidon surveillance aircraft, this was done precisely to boost Norway's submarine hunting capabilities in the sea North of Finnmark.

Oil, Gas, Fish, and Sanctions

As the Barents Sea appears to be becoming an ever more important area for the Russian navy, this is also an arena of ever-increasing economic importance. Throughout history,

in the Barents Sea as well as the need to manage common fish resources in the North. There is also no doubt that sourcing raw material for the Norwegian fish processing companies along the coast is an important consideration for the government. A similar situation may also become relevant when it comes to oil and gas resources in the North.

In 2011, after more than 40 years of negotiations, the so-called dividing line agreement was concluded, an agreement that clarifies the border relationship between Norway and Russia in the Barents Sea. However, the agreement also contains provisions for cooperation on the exploitation of possible trans-border petroleum resources under these sea areas. As of today, no discoveries of viable oil or gas deposits have been made in these areas. But if major oil or gas fields were to be discovered in the areas adjoining the dividing line in the East, it would entail significant challenges with respect to the dividing line agreement provisions on cooperation with Russia, and the sanctions package that the EU and Norway have adopted. At the same time, the EU is pressuring Norway to increase Norway's gas supplies to Europe when Russia shut down its gas pipelines.

Up until the Russian invasion of Ukraine, Norway supplied approximately 21 % of the EU's gas imports. Russia supplied around 43%, and although Norway has increased its production somewhat during the year, it goes without saying that Norway will not come close to replacing the loss of Russian gas in the short term. In the longer term, Norway will probably be able to contribute more to making the EU's gas supply less dependent on Russia, but this will call for new gas fields to be discovered and developed in the Norwegian sea areas. In this respect, the Barents Sea will again be a key area. Norwegian authorities estimate that more than 50% of Norway's as yet undiscovered gas and oil resources lie just in the Barents Sea. If this turns out to be correct, there is a future risk that large parts of the EU will become dependent on gas from a sea area that lies right up against Russia's border, and which is the "shipping route" out into the Atlantic for the Russian Northern Fleet.

Today, one can today only speculate about what challenges this will entail, both when it comes to developing the petroleum business in these areas, or securing, and at worst protecting, the supply of gas to Europe from the Barents Sea. In any case, the development of these hydrocarbon resources to the extent that they can cover most of Europe's gas needs, will lie many years in the future. ■



Photo: Russian MoD

Nuclear submarines have been one of the few areas where the Russian Navy has been given the resources to acquire new equipment. The picture shows a Russian submarine of the new Borei class.

The current number is significantly reduced, comprising some 22 nuclear submarines and 10 conventional submarines. However, nuclear-powered submarines and new weapons for these submarines are among the few areas where the Russian Navy has been allocated resources to invest in after the demise of the Soviet Union, and the Navy has received several new nuclear submarines in recent years.

Russian/Soviet submarines have always been a challenge for NATO, and apart from their nuclear weapons, one can also see from a potentially difficult threat scenario for NATO arising if the Northern Fleet's submarines penetrate the Atlantic Ocean and manage to block the sea connection between Europe and the USA.

To get out into the Atlantic, the Russian submarines need to pass through the Barents Sea, north of Finnmark. This sea area is relatively shallow, with an average depth of approximately 230 m (750 ft), and detecting submarines here is quite simple. Monitoring these sea areas and hunting for submarines has been a priority task for Norwegian defence ever since the Sec-

ond World War, and reports on Russian submarine movements in the Barents Sea have been among Norway's most important contributions to the NATO community. However, the sanctions that have recently been invoked against Russia create problems and new challenges for the Norwegian fishing industry and the Norwegian authorities.

Norway has toed the EU line and introduced the same sanctions package against Russia as other EU countries. The sanctions mean that, among other things, that Russian vessels are not allowed to go into port in EU countries or in Norway. Yet the Norwegian government has made one exception, whereby Russian fishing vessels can go to Norwegian ports to deliver fish. This exception has met with massive criticism from the political opposition, who claimed that Russian sales of fish in Norway go "directly to finance the war against Ukraine". However, the Norwegian government defends Norwegian policy by pointing to its obligation to cooperate with Russia



Capabilities Made in Norway – Norwegian Defence Industry Delivers World-Class Defence Equipment to Armed Forces around the World

Torbjörn Svensgard

Innovation, affordability, and effectiveness are key drivers that have shaped the Norwegian defence industry for more than six decades. Today the industry controls a portfolio of advanced and innovative defence equipment that has been shaped by the operational requirements of the Norwegian and allied armed forces. Norwegian defence contractors are world-leaders in several niches, and close to 80% of their sales are to customers outside Norway.

The Norwegian defence industry has existed for more than 200 years since Norway got its constitution in 1814. Today, the industry is an integral part of Norway's overall defence capability and provides a significant contribution to safeguard the nation's essential security interests. Specific local and regional conditions related to national security, arctic climate, challenging topography, resource constraints, extreme littoral conditions, and the vast ocean areas under Norwegian jurisdiction in the high north, have shaped the Norwegian defence industry and honed the capabilities of the companies and the skills of their employees. The Norwegian armed forces prefer to acquire defence equipment off-the-shelf in the international market. However, for reasons related to the conditions mentioned above, this is not always possible. In such cases, the armed forces cooperate with the Norwegian defence industry to develop bespoke solutions that fulfil the Norwegian armed forces' requirements. Meeting operational requirements in the most cost-effective way is always top priority. Exportability is, however, likewise a mandatory requirement when new equipment and systems are developed. Unit costs and the costs to sustain and maintain

Photo: Kongsberg



The Kongsberg Naval Strike is a high-performance ground based Coastal Defence system.

equipment solely operated by the Norwegian armed forces, by far exceeds what is affordable. Furthermore, the industry must sustain and develop technology and knowledge in between our major national development and upgrade programs. Consequently, export of defence equipment constitutes an integral part of Norway's essential security interests, as a national defence industrial base could not exist without exports.

Within carefully selected technologies and product areas, Norwegian defence industry today possesses some of the most advanced technology and capabilities in the industry and manufactures several products and systems that are leading in the international market. Almost 80% of sales are to customers outside Norway. That is

one of the largest export shares of its kind in the world.

To provide guidance on where the armed forces should spend on defence research and development and seek cooperation with Norwegian industry, the Ministry of Defence has identified a set of prioritized technologies, endorsed by Norway's parliament.

The key technologies are:

- Command and control, information, decision support and combat systems
- Systems integration
- Autonomous systems and artificial intelligence
- Missile technology
- Underwater technology
- Ammunition, propulsion technologies and military explosives

Author

Torbjörn Svensgard is the President and CEO of the Norwegian Defence and Security Industries Association (FSI).



- Materials technology developed or re-fined for military use
 - Lifecycle support for military systems
- To transform these technologies into products and systems, a model for cooperation between the military user community, academia and the defence industry, which has been developed and refined for decades, is applied. This "Triad" facilitates close integration and interaction between the key stakeholders, in particular the military user community, from the very early phases of concept development and experimentation to implementation and transition to operational use.

By utilizing this collaborative framework, Norwegian defence industry can develop, deliver, and export world-class products and systems in the following areas:

- Missiles (NSM/JSM)
- Ground Based Air-defence (NASAMS)
- Rocket motors (AMRAAM, Sidewinder, ESSM, IRIS-T)
- Remote weapon systems (Weapon stations and Turrets)
- Advanced ammunition for all domains (Medium and Large Calibre, Air-Burst, Base Bleed/Rocket assist/Ramjet)
- Shoulder fired weapons (M-72)
- Nano-UAVs (BLACK HORNET)
- Underwater systems (HUGIN AUV, Naval sonars)
- Command- control- and communication systems (Integrated Combat System, NORBMS, FACNAV, NORCCIS, SW-defined radio)
- Secure information systems, Crypto (XO-mail, High Grade IP-crypto, G-A-G VCS, Multilevel security information exchange)
- Soldier systems (Load bearing systems, combat clothing, ballistic protection)

International cooperation is key to the Norwegian defence industry's international



Photo: Kongsberg

The HUGIN UAV marine robot offers a remote subsea survey capability.

success, which made exports grow by more than 400% over the last 20 years. Partnerships are actively searched for as a vehicle to secure market access and technology cooperation. Such partnerships are paramount to sustain the industry's position in the international market today and in the future. All Norwegian defence programs of any significance involve international industry-to-industry cooperation. One of the most important reasons why cooperation has been successful, is that most Norwegian products and systems are platform-independent. Our industry does not deliver major platforms such as armoured vehicles, aircraft, or submarines. Rather than having to allocate resources to keep legacy platforms and systems alive, Norwegian industry can continue to invest in those niches where we have technology and products with potential. Norwegian defence companies are small when compared to the major international contractors; hence, head-on competition is not a viable approach. A flexible approach to cooperation and preparedness to re-

spond quickly to changes and emerging opportunities, have proven successful.

In cooperation with international partners, Norwegian defence industry today manufactures, markets, and delivers "high-end" weapon systems, such as anti-ship and land attack missiles and air defence systems, advanced ammunition, rocket motors, remote weapon systems, sophisticated communication equipment, combat management systems, personal reconnaissance systems, soldier systems and many more, to customers in more than 50 nations worldwide. The biggest and most important export market by far is the United States. NATO allies and EU member states count for approximately 90% of defence exports from Norway. However, markets further away, such as Australia, South-East Asia, and The Middle East, are also important.

Norway's participation in international collaborative armament programs is also another important contributor to the growth of the Norwegian defence industry.

Norway is a partner in the US-led F-35 Joint Strike Fighter program. This has created opportunities for several Norwegian companies. Norwegian industry's contribution to the F-35 includes advanced composite parts and subassemblies, electronics, mechanical components, and support services. A fully-fledged engine depot has been established in Norway to provide overhaul and repair services for the F135 engines. A new 5th generation long-range joint strike missile (JSM), required to provide F-35 the operational capability required by the Norwegian air force, is already in production, with Norway and Japan as launch customers. A new armour-piercing ammunition nature (APEX) for F-35, also developed by Norwegian industry, will increase the aircraft's combat effectiveness against land targets and for close air support operations. JSM and APEX are excellent examples of how the Norwegian government



Photo: FLIR

The BLACK HORNET Nano UAV is the world's smallest operational UAV and is developed and manufactured in Norway.



and Norwegian industry invest to enhance the operational capability of F-35 to meet national requirements that buying off-the-shelf cannot attain.

On the naval side, Norwegian industry has developed the shipborne long-range, low-observable Naval Strike Missile (NSM) with anti-ship and land attack capability for sea and ground launch applications. The missile is currently in operation with the Norwegian, Polish, Malaysian and US navies. The US Marine Corps (USMC), Germany, Australia, Romania, and Spain have all ordered NSM and will introduce the missile soon.

the art. The technology provides the operational user the capability to navigate and maintain situational awareness under water with extreme precision. Likewise, anti-submarine warfare and mine countermeasures are also core capabilities of the naval industry. Norwegian industry offers advanced Autonomous Underwater Vehicles and is the preferred industrial partner for Norwegian navy developing the next-generation autonomous mine warfare capability.

The NATO Evolved Sea Sparrow and the European IRIS-T missiles get their propulsion from a Norwegian company. The motor for

Norwegian Defence Industry – Key Facts

- Revenues 2,3 bn EUR/yr.
- ~ 80% of sales outside of Norway
- 7500 man-years
- ~180 companies
- SMEs >85 %
- International presence (Production/R&D)
 - USA, Canada, Sweden, Finland, Poland, Germany, Switzerland, Spain, Bulgaria, France, UK, Ireland



Photo: US Air Force

The motor for the AMRAAM missile, which is the primary weapon for US and NATO air forces is developed and manufactured in Norway.

A year ago, Norway and Germany agreed to jointly develop and build six identical submarines, four for Norway and two for Germany. Expectations are high that common submarines will provide significant cost-savings throughout the lifetime of the boats. The program facilitates integration of Norway's and Germany's industrial capabilities in the field of submarines. This is governed by a strategic partnership agreement that assigns roles, responsibilities, and tasks to the industrial partners for the next 40 years. Furthermore, the cooperation also includes a strategic partnership for development of the next generation of the NSM-missile, which will be operated by both the Norwegian and the German Navy. In this regard, a long-term strategic partnership between Norwegian and German industry in the field of anti-ship missiles has been created.

The complex oceanographic conditions along the long Norwegian coastline require bespoke solutions for underwater acoustic applications. Norwegian sonar technology, and in particular the capability to process underwater acoustic data, are state-of-

the-art. The technology provides the operational user the capability to navigate and maintain situational awareness under water with extreme precision. Likewise, anti-submarine warfare and mine countermeasures are also core capabilities of the naval industry. Norwegian industry offers advanced Autonomous Underwater Vehicles and is the preferred industrial partner for Norwegian navy developing the next-generation autonomous mine warfare capability.

The NATO Evolved Sea Sparrow and the European IRIS-T missiles get their propulsion from a Norwegian company. The motor for the AMRAAM-missile, which is the primary weapon for US and NATO air forces is developed and manufactured in Norway, as is the motor for the Sidewinder missile. Norwegian industry has delivered motors to the European Exocet Block 3 and recently the LMM missile.

In the field of advanced ammunition, Norwegian industry is making considerable progress. One of the primary four remaining advanced ammunition manufacturers in Europe is headquartered in Norway. New concepts like programmable ammunition, ramjet-propelled artillery grenades and advanced shoulder-launched weapons, are in the pipeline to improve combat effectiveness of war fighters, combat vehicles and artillery.

NATO AWACS, NATO AGS and NATO ACCS are other examples of international programs where Norwegian companies deliver critical software and support. Another success story is remote weapon systems. Norwegian industry is the market leader for remote weapon stations with a global market share of close to 90%. More than 20,000 weapon stations have been

delivered to 28 countries in cooperation with armoured vehicle manufacturers in both US and Europe.

The Norwegian NASAMS ground based air-defence system has become a benchmark for medium range air defence systems in NATO. 13 nations, including the US, currently operate the system. NASAMS has provided air defence coverage to the White House, US Congress and The Pentagon, 24 hours 365 days a year for more than 15 years, and the system will shortly also be operational with the Ukrainian armed forces.

The BLACK HORNET is the most advanced and capable nano-UAV available. The world's smallest operational UAV is developed and manufactured in Norway. It weighs only 30 grams, still it can provide real time HD-video, night and day, using a proprietary datalink with an effective range of more than 1.5 km. The vehicle can operate in GPS-denied environments and in severe weather conditions. It provides the warfighter with situational awareness, enhanced combat effectiveness, and significantly improved safety. More than 40



nations have acquired the system, among them the US for the Army Soldier-borne Sensor program and the Ukrainian army. Secure information systems and advanced communications for mission critical applications are other areas where the industry excels. For more than 20 years, Norwegian industry has been the sole supplier of crypto solutions for "high grade" IP-networks in NATO. Secure email and secure G-A-G voice communications are other areas where Norwegian industry is the preferred supplier to NATO.

In addition to the major companies delivering the systems and products mentioned above, the industry also comprises a significant number of high-tech SMEs, with highly specialised products. Advanced communication equipment, surveillance systems, antennas, sensors, weapon improvement solutions, command and control systems, camp solutions, medical technology, and high-end UAVs and USVs are some examples.

There is also a plethora of highly skilled subcontractors that are closely integrated in the supply chains of the major Norwegian defence contractors as well as of the leading European and US OEMs. Advanced high quality electronic assemblies and sub-assemblies, high-end equipment for data recording, processing and storage, cables and connectors, complex mechanical structures and sub-assemblies, software, and services are among what can be found.

The future belongs to those who can adapt quickly. Technological development accelerates, in some areas, exponentially. Emerging and disruptive technologies create potential for developing completely new solutions to existing problems and challenges. In some areas, however, they may also imply new threats and operational challenges. Artificial intelligence, machine learning, big data, hypersonic weapons, and space technology are areas scientists predict may have disruptive effects on military operations, and hence equipment and systems within 5-10 years. Flexible, non-bureaucratic organisations with low hierarchies and short lines of communication, will continue to be a competitive advantage for Norwegian defence. The ability to respond quickly to customer requirements and needs, and to introduce new technologies without unnecessary delay, will become a prerequisite for survival.

Norway and Norwegians are early adapters of new technology. The Norwegian Defence Industry is no exception, already working intensely to understand the potential and challenges these technologies will pose as they mature. For example: Ad-

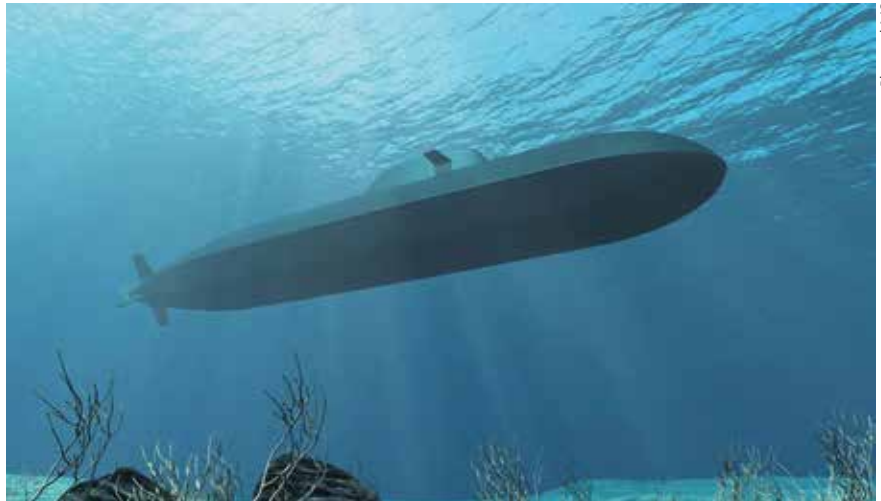


Photo: tkMS

Norway and Germany agreed to jointly develop and build six identical U-212 CD submarines, four for Norway and two for Germany.

vanced algorithms that provide counter-UAV systems with the ability to increase effectiveness by automatically analysing logs from past usage have been put into operation. 155 mm ramjet artillery ammunition is in development and has already been fired successfully. Taking into consideration the extreme timelines for development and fielding of military equipment, understanding the impact of new technology, and in particular EDTs, will be critical to be able to deliver state of the art equipment in the future.

The Norwegian defence industry is in better shape than ever. Sales, order intake, backlog and workforce are "all time high". Plans

for customers worldwide. The industry is prepared to respond to present and future needs of the Norwegian and allied forces to enable them to deter, defend, and if needed fight to safeguard our societies and our people.

About The Norwegian Defence and Security Industries Association (FSi)

The Norwegian Defence and Security Industries Association (FSi) is the only trade association in Norway dedicated to advocate the interests of the Norwegian Defence and Security Industries. The association is the primary interlocutor and partner for the Norwegian government in matters of importance to the industry.

FSi's mission is to foster framework conditions for member companies to succeed in the domestic and global defence and security markets, thereby contributing to Norway's national defence and security goals. FSi is also a focal point for foreign contractors seeking cooperation with Norwegian companies in relation to Norwegian defence procurements abroad and international collaborative programs.

The association has approximately 180 member companies - a diversified group ranging from the major national defence contractors to one-person businesses, all with unique capabilities built on innovation and advanced technology, serving both the military and the civil security markets. Approximately 85 per cent of the companies are SMEs.

FSi is an independent private association owned, governed and funded exclusively by the members. The association is affiliated and collocated with the primary business association in Norway, The Confederation of Norwegian Enterprise (NHO). ■



Source: FSi

The Norwegian Defence and Security Industries Association (FSi) is the advocate for the Norwegian defence industry.

for further growth are being implemented and considerable resources are invested in increased capacity, upgrade of production equipment and in building competence to take advantage of the technologies of the future. A mature and modern product portfolio, funded development programs, wide international market presence and a web of strategic alliances with international partners, makes the industry an attractive and reliable supplier and partner

Saab Conducts Successful MSHORAD Live Fire Demonstration

Mark Cazalet

On 5 September 2022, Saab announced that they had conducted a successful live fire demonstration of their MSHORAD system on 30 August at the Karlskoga range in Sweden. During the test, five different mock aerial targets were successfully engaged, including UAV, helicopter, close air support

with C2 functions decoupled from the radar vehicle, an arrangement which decreases the command crew's vulnerability to anti-radiation missiles. The GIRAFFE 1X used by the MRU is an active electronically scanned array (AESA) radar operating in the X-band, which can provide coverage up to 70°

consisting of a driver, radar operator, and battery commander, in the MFU, and driver, missile operator, and vehicle commander for the MFU. The three-vehicle configuration would presumably involve moving the battery commander from the MRU to a dedicated C2 vehicle, along with a driver. The company stated

Photo: SAAB



The new MSHORAD by Saab

(CAS) aircraft representative targets, and also included a night engagement against a towed target. For the purposes of the demonstration, MSHORAD was shown in a two vehicle-type configuration, consisting of a Mobile Radar Unit (MRU) equipped with a GIRAFFE 1X search radar as well as command-and-control (C2) systems, and a mobile firing unit (MFU) with a pedestal-mounted, remotely-operated launcher with three ready missiles, derived from the RBS 70 NG system. Saab stated that depending on user preference, MSHORAD could also be offered in a three vehicle-type configuration,

in elevation and rotates to provide 360° coverage in azimuth. It capable of tracking 600 simultaneous targets, out to its instrumented detection range of 75 km, and has a refresh rate of 1 second. Notionally, a single MRU would be capable of providing simultaneous tracking for 4-12 MFUs, although a company representative stated more could be supported if required. Additionally, MRU's networking capabilities allow combining the air picture from multiple MRUs to generate a larger common air picture. In the two vehicle-type configuration, the MRU and MFU are each intended to operate with have a crew of three,

that additional sensors, such as passive sensors, could be integrated with the system depending on user requirement. For the demonstration both vehicles were shown mounted on the MARS S-330 4x4 platform developed by Czech manufacturer SVOS. However, SAAB noted that both the MRU and MFU are platform-agnostic, and can be mounted on nearly any vehicle which can withstand the weight requirement of 500 kg for the missile launcher. SAAB also offer a pre-packaged version of the radar unit, referred to as the Compact Radar Unit (CRU), which they have stated can be mounted to nearly any flatbed vehicle capable of meeting

the 400 kg weight requirement and 2.5 kW power requirement. The CRU comes equipped with a battery which allows up to 8 hours of silent watch capability, allowing the crew to power the radar without using the host vehicle's engine.

The MFU can be armed with three of either the RBS 70 Mk2 or the BOLIDE laser beam-riding missile, with the latter enabling engagement of aerial or protected land vehicle targets out to 9 km, at altitudes up to 5 km. The vehicle's unmanned weapon station is equipped with a thermal sight, allowing the vehicle to search for and conduct engagements independently of the MRU if required, such as in electromagnetically-contested environments.

According to the Saab, the sight and missiles used by the mobile variant are both the same as those used on the RBS 70 NG MANPADS. The company stated that this allows the missiles plus sight to be dismounted from the vehicle, and remounted on a tripod carried by the MFU to set up a MANPADS configuration of the system if required. This may be desirable in some



Photo: SAAB

The system's compact radar unit

tactical scenarios, such as when fighting in an urban environment. In this configuration, the MANPADS configuration could receive target cueing information from the

MRU either from the vehicle's radios, via a fibre optic datalink run between vehicle and launcher, or using a dedicated radio for the MANPADS configuration. ■

“Special Attention will be Paid to Innovation.”



Photos: SOGENA/EURONAVAL

The 2022 edition of the biennial EURONAVAL exhibition will be held in Paris-Le Bourget from 18 - 21 October 2022. ESD was granted an exclusive interview with Hugues d'Argentré, Director of SOGENA, the organizer of the event.

ESD: The EURONAVAL 2022 exhibition will be held in Paris-Le Bourget from 18 - 21 October 2022. How many exhibitors from how many countries do you expect, and what will be the particular highlights of the event?

d'Argentré: Based on the current registrations and the participants of the 2018 edition, (EURONAVAL 2020 was an entirely online event with 10,500 visitors, 1,300 business meetings and 3,500 conference participants), we expect more than 450 exhibitors from all over the world, even if the

Russian-Ukrainian war and the consequences of the COVID pandemic should make us cautious.

The exhibition is taking place at a time when many coastal countries want to strengthen and improve their navies. The subject of this show will be the return of high intensity conflicts with a focus on robotics, cyber and high seas naval forces.

As at all the shows, special attention will be paid to innovation. A space dedicated to start-ups in the naval sector will host some

40 companies that will be able to meet with major naval defence companies and thus contribute to the future of navies and services acting at sea.

ESD: Will there again be an accompanying conference? And if so, what will be the subjects addressed in the conference?

d'Argentré: Two vision conference roundtables, organised in cooperation with the Centre d'Etude Stratégique de la Marine (CESM) and the Fondation Méditerranéenne d'Etude Stratégique (FMES), will be held on 03 and 10 October, prior to the exhibition, on the subjects of "Global Rearmament" and "The Maritime Consequences of the Russian-Ukrainian Conflict".

A symposium will be also held in Paris on 17 October, the day before the exhibition, in cooperation with the Foundation for Strategic Research (FRS) on the topic of "Naval Forces Facing High-Intensity Combat" and "Naval Warfare and Technological Advantages", with the much-anticipated speeches of the French Navy Chief of Staff, the Delegate General for Armaments and the President of the French Marine Industry Association (GICAN), who also holds the position of EURONAVAL President.

Finally, throughout the show, many workshops will be held at the Le Bourget site, covering all the issues and innovations that are of interest the naval defence arena. For this purpose, a call for talks has been sent to all exhibiting companies to offer them to participate in these conferences and exchanges. All these round tables, conferences and workshops will bring together military, industrial, diplomatic and academic experts to make these exchanges strong moments of strategic and technical reflection for the benefit of marine evolution and their use.

I would also like to point out that we will produce, for the second time, in cooperation with Janes, GICAN and Praxial, a study on the world shipbuilding industry which will present the state of production of shipyards from all continents as well as the state of navies and their main equipment programmes. This study will be presented at the exhibition and will be published for the benefit of EURONAVAL 2022 exhibitors and visitors.

ESD: To what extent do the French Government and the French Navy support EURO-NAVAL 2022? Are the Government and the French Navy inviting delegations on their own?

d'Argentré: The French Ministry of the Armed Forces and especially the General Delegation for Armament and the French Navy are essential supporters of the exhibition. First of all, by their presence with a large stand presenting innovations and upcoming programmes for the French Navy. Secondly, by high level contributions of French Navy officers and DGA engineers to the conferences and workshops organised on and around the show. There is also the Minister of the Armed Forces and the higher authorities of the Ministry, who invite their counterparts from foreign countries to visit the exhibition. Last but not least, the Minister of the Armed Forces will open the exhibition on the morning of 18 October.

The exhibition also enjoys the support of the Secretary General of the Sea who, under the authority of the Prime Minister, is responsible for the Action of the State at sea.

ESD: Obviously, this year's event will again be affected by the global Covid-19 pandemic. Do visitors and delegation from e.g. the Americas, Asia and Africa have to expect to be quarantined?

d'Argentré: If the show were to open next week, there would be no sanitary restrictions for French or foreign visitors, but there would be an incentive to be cautious and to respect the precautionary measures. We do not know today what the situation will be in mid-October, in France, Europe and the world but we are resolutely optimistic.

ESD: So, how many delegations and from which countries do you expect?

d'Argentré: It is still premature to take a precise count, but we expect more than 130 delegations from nearly 75 countries. We will have a more precise picture in October, a few days before the opening of the EURO-NAVAL exhibition.

It is likely that after two years without a naval exhibition due to the pandemic and with the rise of insecurity and armed conflicts in the world, especially in the Pacific Ocean and on the border of Europe, many coastal states will be interested in sending delegations of decision makers and experts to visit the EURONAVAL exhibition, which remains the most important naval exhibition in the world.

ESD: Is there a "Plan B", just in case another COVID-19 wave excludes the physical presence of the expected numbers of exhibitors and visitors?

d'Argentré: We are resolutely optimistic, but in the unlikely event that the exhibition cannot be opened due to a return of the pandemic, we will maintain, as we did in 2020, a EURONAVAL-Online which will allow all interested visitors to have access on our website EURONAVAL.FR, in live and in replay, to all the conferences and workshops scheduled.

ESD: Within the European naval shipyard community there is currently a trend towards consolidation. How do you assess this trend, and which European shipyards have reserved space at the exhibition?

d'Argentré: The vast majority of the major European shipyards will be present at EURO-NAVAL 2022, but also shipyards and equipment manufacturers from all continents. As you know EURONAVAL is the most important naval exhibition and remains the only naval exhibition in the world where the industries are guaranteed to meet all the representatives of the world's navies. We invite you to come and meet them and discover their innovations and services, to reinforce peace and security at sea, and from the sea.

The questions were asked by Jürgen Hensel.

Index of Advertisers

ADL	39		
Aselsan	17	MBDA	11
Bofors Test Center	57	Mittler	55, 63
IAI	5	Oshkosh Defense	2 nd cover
IDEAS	3 rd cover	Raytheon Elcan	4 th cover
iXblue	37	Safran	41
Kärcher Futuretech	25	Secunet	19
Koehler	111	SOFEX	31
LAAD	43	WB Group	47
Leonardo	27, 35	Weibel	45, 53

Cyber Warfare in Eastern Europe

Andreea Stoian Karadeli

More than eight months into the Russia-Ukraine war, Europe is sailing on full speed towards a dangerous iceberg, that is now only showing its peak: the increasing concerns regarding energy supplies. A deeper dive into European affairs would reflect a challenging crisis encompassing different dimensions that are as complex as they are interrelated.

While some of them were triggered by the ongoing Russia-Ukraine war, others were pre-existing, and the evolution of the recent events had only served to amplify them. Such is the case for cyber warfare in the Eastern European context – a threat that reached a completely different level in 2022, teaching us valuable lessons about the battlefield of the future.

Lt. Gen. Maria Gervais, USA, deputy commanding general and chief of staff, U.S. Army Training and Doctrine Command (TRADOC), a keynote speaker at AFCEA's TechNet Augusta Conference that took place in Augusta, Georgia, back in August this year, emphasized in her speech that if one is interested to see how a modern battlefield is impacted by EW and cyber warfare, the events developing in Eastern Europe are a perfect example: "Everything that we are seeing in Ukraine has implications for a unified network, and almost certainly represents the type of threats we will see." Bearing in mind that the invasion started by President Vladimir Putin on 24 February 2022, has been backed by a diverse arsenal of cyberattacks and expanding information war throughout Eastern Europe, the War in Ukraine proved to be the first full-scale cyberwar. While we think that we are only witnessing it in real time, we are just starting to notice and understand its heaviest consequences.

Author

Dr Andreea Stoian Karadeli is an independent researcher based in Turkey, an Associate Fellow at the Geneva Centre for Security Policy and a Visiting Researcher at the University of South Wales. Her interdisciplinary research varies from cultural and intercultural studies to conflict resolution and focusses on national security and terrorism, with a specific expertise in the Middle East.



Photo: US Army/Maj. Kurt Rauschenberg

Md. Guard cyber warfare operators from the 175th Wing's Cyber Operations Group support Exercise Hedgehog on 7 May 2018 in Southern Estonia. The Cyber personnel advise and assist Estonian Defence Force and Estonia Defence League members to evaluate internal policy for cyber-related activities.

The Eastern European states are no strangers to the threats of cyber warfare, and they have already faced the effects of digital technologies' dual potential as tools for both societal advance, and weapons for international aggression. Leaving aside all that has been experienced so far, the current context marked by the War in Ukraine, changes the traditional understanding of cyber security in Eastern Europe, the first line on the battleground, and beyond it. Ever since the first cyber-attack by one state against another, Russia's 2007 cyber-attack on Estonia, the threat of a future battlefield that is no longer limited to the physical space has pushed for the development of competing defensive and offensive strategies adapted to the complex digital capabilities that are no longer a matter of the future. After nine years, in 2016, NATO officially recognized cyberspace as a field of military operations alongside

the more traditional domains of land, sea and air.

Google's Threat Analysis Group (TAG) has been closely monitoring cybersecurity activity in Eastern Europe with regard to the war in Ukraine, and it has observed a continuously growing number of threat actors using the war as a lure in phishing and malware campaigns. In line with several reports from both private and public sector institutions, TAG has underlined that threat actors increasingly target critical infrastructure entities including oil and gas, telecommunications, and manufacturing. According to the reports, government-backed actors from China, Iran, North Korea, and Russia, as well as various unattributed groups, have used various Ukraine war-related themes to get targets to open malicious emails or click malicious links. Financially motivated and criminal actors are also using current events as a means for targeting users.

Photo: US Cyber Command/CPO Jon Dashed



Military and policy leaders from multiple nations engage during US Cyber Command's CYBER FLAG 21-1 exercise. The exercise took place at Joint Base Suffolk, Virginia from 15-20 November 2021, and helped more than 200 cyber operators from 23 countries bolster their defensive skills.

The War in Ukraine is taking place both within the physical borders of the Ukrainian land, and, in a completely different environment – the digital space is not confined to Ukraine or Eastern Europe. Today, the main drivers of modern international security are being redrafted, and old cards are thrown to the table backed by new rules and new strategies, in a complex game of intersecting variables that target the fundamental elements of our societies. As our governments are struggling to adapt and learn

to ride the new tides, we need to understand the track of the new currents: the main changes, their reasons and the consequences of a cyber warfare that has been developing in Eastern Europe long before the 24th of February.

New Generation Warfare

Nine years before the 2022 Russian invasion of Ukraine, back in February 2013, Russia's Chief of the General Staff, General Valery Gerasimov, published an ar-

ticle in the weekly Russian trade paper Military-Industrial Courier. The short piece was drafted intentionally to provide a glimpse into the Russian perspective regarding the evolution of warfare. Under the title "The Value of Science is in the Foresight", Gerasimov suggested that the "very 'rules of war' have changed," and that in many cases, nonmilitary means have exceeded the power and force of weapons in their ability to effect change on the international stage. Arguing that new technologies have reduced gaps between traditional forces and their command and control, Gerasimov underlined the fact that "frontal engagements of large formations of forces at the strategic and operational level are gradually becoming a thing of the past." Moreover, Gerasimov predicted that the future lay in "contactless actions" — cyber or other electronic means — being used as the main means of attaining military or intelligence goals.

The short article reflected in broad lines Russia's thoughts on the evolving battlefield, adapted to the newest technological transformation, and proposing an evolved type of warfare, conducted in both physical and digital spaces, adopting a guerrilla approach on all fronts, with a wide spectrum of actors and tools as conventional and asymmetric military tactics. The problem set identified by Gerasimov eventually crystallised into a set of ideas referred to as 'New Generation Warfare' in the Russian military community, or 'Cross-Domain Coercion' in the West. In part, this held that traditional military hard power interactions could be either

Photo: US Cyber Command/CPO Jon Dashed



Two Estonian defensive cyber operators, wearing the insignia of the Estonian Defence Forces' Cyber and Information Operations Centre, test their skills and ability to detect enemy presence, expel it, and identify solutions to harden simulated networks during US Cyber Command's CYBER FLAG 21-1 exercise.

less necessary or much more effective when supplemented by newer and subjectively more effective indirect interactions in the digital sphere. This provided a framework for non-military measures to become a vital part of warfare, as important as the use of force, and, in the Russian perspective, the lower-cost way to win. Gerasimov underlined that the objective is to achieve an environment of permanent unrest and conflict within an enemy state. Nothing related to Gerasimov's article was random or without a specific strategic target. Even the date chosen for the publication proved to be a warning before the 2014 Russia's invasion of Ukraine, that was the result of both physical and digital tools, a technique practiced for longer than a decade in various forms and contexts such as Estonia in 2007 and Georgia in 2008.

Russia's 2007 cyber attack on Estonia was initially targeted to prevent the relocation of a Soviet-era monument commemorating the Red Army's "liberation" of Estonia. A few weeks after Estonia decided to relocate the Soviet-era statue from the centre of Tallinn to a military cemetery, unidentified hackers launched a series of distributed denial-of-service (DDoS) attacks. While for many Estonians, the monument represented the Soviet Union's decades-long subjugation of the country during the Cold War, for Russia, it was a symbol of Soviet sacrifice in defeating the Nazis in World War II. The series of cyber attacks directed towards the Estonian government and information systems lasted for 22 days, and were backed by protests from Russian-speaking Estonians, and intense disinformation campaigns. However, Russia's first practical attempt of this practice, did not include any military intervention.

Further on, the cyber-attacks targeting Georgia back in 2008 reflected a more complex plan: pre-formed botnets conducting a larger-scale DDoS attack, but now paired with an incursion of troops and tanks and a traditional military movement into South Ossetia.

In 2014, the first Russian invasion of Ukraine was perhaps the most complete example of 'New Generation Warfare' in practice: cyber-attacks conducted in parallel with military incursion and occupation. In the aftermath of the events, several international reports made a detailed assessment of Russia's strategy, emphasising the main elements such as simultaneous attacks on media firms, an attack on the Central Election Commission's website that triggered the announcement of an ultra-right-wing can-

didate as winner of the election, and a takeover of networks controlling local power grids. Chaos was achieved, and the Russian 'New Generation Warfare' passed its first major trial.

Eastern Europe's Cyber Warfare Experience

The attacks that have targeted Eastern Europe reflected three different ways in which Russia plays its 'cyber card': as preparation for military conflict, as part of a 'hybrid war', or as an isolated threat signal and complement to diplomatic warnings. During the second invasion of Ukraine, in February 2022, the Russian attacks on critical infrastructure such as government websites, IT servers, banks, media outlets, and power plants provid-

ent technology to disrupt societies and organisations. During wartime, Russia deploys cyberattacks with greater frequency, targeting critical infrastructure and conducting military action simultaneously. In the context of political or hybrid war situations, cyberattacks are backed by disinformation and civil actions and seek to substitute for military action by achieving some goals with lower risk. At other times, cyberattacks accompany diplomatic warnings to other countries and international organisations.

On April 27, 2022, Microsoft's Digital Security Unit issued a report of all known Russian cyberattacks on Ukraine in the first months of the war. The report concluded that the Russian military intelligence service (GRU), foreign intelligence service (SVR), and federal security ser-



Photo: US ArmySgt. Thomas Lamb

Members of Cyber Protection Team 169, Maryland Army National Guard, hunt for malicious activity on their network at the Laurel Readiness Center in Laurel, Md., during CYBER FLAG 22, 25 July 2022.

ed the opportunity to further advance the military campaign.

The cyber attacks against Romania and Bulgaria reflect attempts at achieving lower-order effects, as small-scale cyber-attacks combined with disinformation campaign and civil actions, aim to create chaos and confusion among the population, making national coordination more difficult. Last, but not least, cyberattacks like the one that targeted Estonia back in 2007 are an example of the 'cyber card' used as diplomatic warning. A recent example were the cyber attacks on Moldova, following the country delivering its request for EU membership candidate status in May 2022.

All three ways of using cyber attacks reflect the Kremlin's interest in using cur-

vice (FSB) "have conducted destructive attacks, espionage operations, or both, while Russian military forces attack the country by land, air, and sea." The objective, the company added, was "to disrupt or degrade Ukrainian government and military functions and undermine the public's trust in those same institutions." The same report emphasised the increase in the number of cyberattacks at the end of 2021 and start of 2022, that could have represented a warning about the war that was about to start. The number of Russian cyberattacks against Ukraine identified by Microsoft rose from 15 in December (2021) to 125 in March (2022). According to Microsoft's assessment, Russia began preparing for cyberattacks against Ukraine in March 2021, at around

Photo: USAF/Joseph Eddins



A cyber-warfare specialist serving with the 175th Cyberspace Operations Group of the Maryland Air National Guard at Warfield Air National Guard Base, Middle River, Md.

the same time as Russia began to deploy troops along their shared border. Therefore, the purpose of 'preparatory' cyber-attacks was to collect military and foreign policy intelligence and gain access to critical infrastructure, such as energy and IT service providers.

Moreover, Microsoft concluded that "destructive attacks signal imminent invasion." It noted that Russia unleashed the destructive WhisperGate wiper (which deletes the contents of hard drives and renders computers unbootable) on a limited number of Ukrainian "government and IT sector systems" when diplomatic talks between Russia, Ukraine, NATO, and EU nations failed on January 13, 2022. Russia followed with DDoS attacks on Ukrainian government websites. On the eve of war on February 23, 2022, Russia's GRU threat group, 'Iridium', unleashed another destructive wiper, FoxBlade, on hundreds of Ukrainian military and government networks simultaneously. Microsoft also observed connections between specific military actions and cyberattacks. For instance, cyberattacks were geographically concentrated around Kyiv and in Donbas, and targeted Ukraine's nuclear power supplier at around the same time that Russia occupied Ukraine's largest nuclear power plant in Zaporizhzhia. During wartime, Microsoft concluded, cyberattacks are more frequent, more destructive, and coordinated with military action.

Lessons Learned and EU Progress

Acknowledging that the EU has made long-term changes which will improve its cybersecurity, especially through its most recent Strategic Compass, there is still a long way ahead to make the necessary short-term changes that will have the power to guard member states against potential Russian cyberattacks. Whatever change is to be made, it must be based on the lessons drawn from the 2022 invasion of Ukraine, as the most recent example of Russia's 'New Generation Warfare'. While the ongoing war can be regarded as the world's first large-scale conflict featuring heavy use of cyber attacks, it will likely not be the last of its kind. Instead, the current times mark the beginning of a transformative change in the global understanding of traditional and modern warfare. From now on, it is hard to imagine future conflicts without taking into consideration the cyber component. Therefore, cyber security has become almost as important as a conventional military.

Emphasising the relevance of international cooperation for developing strong cyber capacities, we must also stress the importance of individual responsibility in the form of civil, national, and organisational strategies against cyber attacks. In this regard, access to verified information and developing a high level of digital literacy should be highly prioritised by our governments.

Moreover, EU should continue updating and revising the Network and Information Security (NIS) Directive to further strengthen the security of supply chains, streamline incident reporting obligations, and introduce more stringent supervisory measures for many operators of essential services and enterprises across its political and economic space. Taking into consideration the obstacles faced so far, implementation of future strategies should aim toward commonality and harmonisation, instead of separate cybersecurity regulations. In addition to the struggle for unification of policies and rules, another goal for the EU should be discouraging and deterring cyber attacks by demonstrating the willingness to act and impose costs on perpetrators through coordinated attribution of cyber attacks at the EU-level. Further on, obstacles to intelligence sharing faced by member states will continue to provide opportunities for future attacks, and as such a solution here is vital. Equally important is the creation of a convergent cooperation mechanism for military security alerts – a goal that was part of the 2014 EU Cyber Defence Policy Framework. Despite its urgency in the current context, the cooperation mechanism is still not complete.

As the states in Eastern Europe continue to represent a direct target and the first line in the digital battle, one of the main lessons that both the EU and the international community needs to learn is that cyber operations should not be treated as an independent warfare tool. Instead, the current strategy should be adapted to fully integrate the cyber dimension into modern combat. In Eastern Europe, Ukraine has been regarded as the main cyber attack testing ground for Russia. At present there is little common agreement about Russia's cyber potential, opinions varying from one European country to the other, mostly based on their own experiences. For instance, Lithuania's head of cybersecurity, Colonel Romualdas Petkevicius, believes that the Russian ability to wage coordinated cyber and kinetic war is still limited. In agreement with Colonel Petkevicius, General Didier Tisseyre, head of France's cyber defense force, made a similar observation about a disconnect between computer attacks and Russia's military offensive on the ground. Bearing in mind the multitude of actors that became involved in a cyber attack, any kind of analysis or assessment needs to be taken with a grain of salt. Still, the current Eastern European cyber warfare experience represents our chance to understand and adapt to modern cyber operations, adding an important dimension to our understanding of war. ■

Developing Excellence in EOD

The NATO Explosive Ordnance Disposal Centre of Excellence (NATO EOD CoE) is one of the tools of the NATO Supreme Allied Commander for Transformation aiming to improve military capabilities, value and efficiency of the Alliance. The Centre was established by Slovakia as the Framework Nation with support of the five Sponsoring Nations - the Czech Republic, France, Hungary, Poland and Romania. The Operational and Functional Memoranda of Understanding were signed in 2010 and the NATO EOD CoE was fully accredited in 2011. Presently, 26 soldiers and 20 civilian experts work at the EOD CoE to enhance NATO capabilities and to ensure its operation including logistic, legal and administrative self-sufficiency. Core tasks for the EOD CoE are:

- Analysing lessons learned from both operations and training.
- Offering training, education and exercise support to NATO members and partners to improve interoperability.
- Assisting in doctrine development and standardisation.
- Testing and concept validation through experimentation.

Among many CoE achievements, the most appreciated product is the Home-made Explosive Course, which has been continuously updated and delivered for 10 years now. To obtain a deeper understanding of the organisation and its present concerns, ESD interviewed Colonel Róbert Császár of the Slovakian Army, director of the NATO EOD CoE.

ESD: Dear Colonel, would you please describe the NATO EOD CoE, your size, capabilities and tasks?

Col. Császár: The Centre is rather a middle size in comparison to other CoEs. The Centre's mission is to support and enhance the NATO transformation and operational effort in the field of EOD. We plan our tasks to support the four CoE pillars which are Education, Training and Exercise and Evaluation, Analysis and Lessons Learned (LL), Doctrine development and Standardisation, Concept development and experimentation. The basic principle of CoE is an added value and no duplication, therefore, we organise activities which are not provided by national EOD capabilities. We organise EOD workshops, exhibitions, conferences, specialised EOD training and seminars, develop handbooks and

databases, execute innovative projects to smoothen EOD specialisation advance. All tasks are developed based on the long-term vision and incorporated in the Strategic plan approved by Steering Committee for 5 years. Among flagships, I can name projects like Demonstration & Trials, EOD Workshop, Integration of the Exoskeleton in the Battlefield, Virtual and Extended Reality training kit, Former Warsaw Pact Ammunition handbooks.

ESD: What is your role in the NATO Defence Planning Process (NDPP)?

Col. Császár: National defence plans are harmonised through NDPP and our role is only advisory as Subject Matter Experts (SMEs). We provide our recommendations and proposals especially to Capability Codes and Capability Statements improvement based on recent LL, new standards or developments. The EOD CoE is the entity that represents the EOD specialisation at the Defence Planning Advisory Group meetings. Furthermore, in order to contribute to better understanding of the future security environment and the long-term perspectives, the CoE's SMEs participate in the Framework for Future Alliance Operations (FFAO) and the Strategic Foresight Analysis (SFA) workshops which outputs we articulate in NDPP.

ESD: The NATO EOD CoE is working on the AJP-3.18 Allied Joint Doctrine for EOD Support to Operations, what changes will we see there?

Col. Császár: We took the responsibility and custodianship for the EOD doctrine with the consent of NATO nations and approval of MCJSB. The CoE was tasked to develop a new edition in accordance with the guidelines in the Doctrine task while ensuring alignment with the key-stone NATO doctrines mainly promulgated after the last AJP-3.18 edition. Our doctrine is consisting of principles, capabilities, Command & Control and relationship, which explains how to think and utilise EOD forces. In this field, there are no big changes required and most likely the final proposal will meliorate or specify some of the definitions and terminology to support common understanding.

ESD: At present, NATO is returning to alliance defence, what does this change mean for your task or daily work?

Photo: NATO EOD CoE



EOD training is one of the main tasks for the EOD CoE.

Photo: NATO EOD CoE



The EOD CoE trains a variety of EOD techniques.



The EOD CoE also conveys knowledge through demonstrations or symposia.

Col Császár: In principle, I do not foresee any significant changes in our activities, but I believe that our training opportunities and other events will be mainly utilised by NATO nations rather than NATO partners for their capability building. However, an increase of amount/extent of national [requests] for support is expected.

ESD: The CoE is also conducting training, what is your main focus currently?

Col Császár: As [a] NATO-accredited Education and Training Facility with high level quality assurance, our permanent task is to update and improve the next course iteration. Recently, we

have just concluded the HME-Advanced course delivery so post evaluation will take place. We have to conclude it properly but briskly, because the CBRN EOD incident management course preparation already requires our attention and effort.

ESD: Since the end of the mission in Afghanistan, has the threat of IED for NATO forces in current missions got smaller? What are the current developments on the IED side?

Col Császár: Unfortunately, IEDs are still widely proliferated and used by insurgents or terrorist groups. We recognise the increase of IED attacks by utilisation of drones or UAVs. Most of these attempts are relatively small with regards to caused damage but it may change very significantly in a short time. Besides, the regular disposal tasks of EOD/IEDD units, there is a requirement [for] neutralisation of shot down, crash-landed or malfunctioned UAV with explosives. ■



Writing session for the Allied Joint Publication (AJP).



The EOD CoE at one of their workshops.

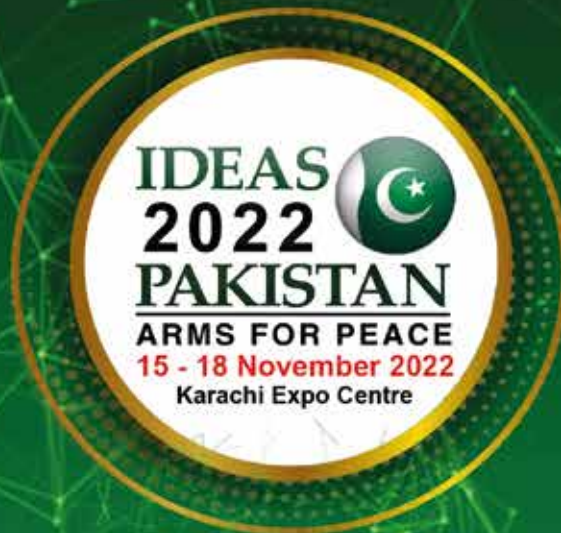


In the future VR/IXR will support EOD/IEDD training.

11th INTERNATIONAL DEFENCE EXHIBITION & SEMINAR

75

Journey to Self Reliance



GLOBAL COOPERATION
STRATEGIC PARTNERSHIP



www.ideaspakistan.gov.pk

ORGANIZED BY

A VENTURE OF



MINISTRY OF
DEFENCE PRODUCTION

SUPPORTED BY



PAKISTAN
ARMED FORCES



DEFENCE EXPORT
PROMOTION ORGANIZATION

ENDORSED BY



TRADE DEVELOPMENT
AUTHORITY OF PAKISTAN

EVENT MANAGER



BADAR EXPO
SOLUTIONS

Official Publisher of Show Daily



Official Online Show Daily
and Official WEB TV



IDEAS SECRETARIAT

C-175, Block-9, Gulshan-e-Iqbal Near Aziz Bhatti Park, Karachi - Pakistan

Tel: +92-21 34821159, +92-21 34821160 Fax: +92-21 34821179 Email: info@ideaspakistan.gov.pk



PRECISION OPTICS

The sharpest optics. For the toughest missions.

At supersonic speeds, where performance is measured in sub-microns, when there is no second chance: Raytheon ELCAN delivers. Our high-precision optical systems give platforms and personnel an unmatched advantage – to see farther, clearer, with greater discrimination, in the harshest environments. For a decisive edge, no matter the mission.



[RTX.com/ELCAN](https://www.rtx.com/ELCAN)