

International Security and Defence Journal

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Editorial



Germany Had the Choice

Sunday, 26 September 2021, was the day when Germans were asked to elect a new parliament – and with it a new – male or female – chancellor. For many Germans, the most drastic change brought about by these elections is the fact that Angela Merkel will no longer be Chancellor in the next legislative period. She is ending her impressive career at the age of 67, although she will continue to be a member of the Bundestag as an ordinary MP. This change in personnel also marked the election campaign. More than ever before, the campaign has been characterised by a focus on the three candidates for chancellor – Annalena Baerbock of the Greens, Armin Laschet of the CDU and Olaf Scholz of the SPD (in alphabetical order, for heaven's sake...). The people – not the political programmes of their respective parties – were at the forefront of public discussion, and weeks before the election it was already apparent that there would be a change in the composition of the Government. Previously, Germany had been governed for three legislative periods – twelve years – by a so-called grand coalition of CDU/ CSU (centre/right, the CSU is the sister party of the CDU and only active in the state of Bavaria) and SPD (centre/left). However, both major parties had already announced before the election that a continuation of the grand coalition was out of the question for them.

With almost 26%, the SPD emerged as the strongest party in the elections, which – as this issue is going to press – is expected to join the Greens (14.3%) in coalition talks with the FDP (Free Democrats, 11.5%) or the Left Party (5%) to form a government under Chancellor Olaf Scholz. Scholz is the only one of the three candidates who also held a ministerial post as finance minister in the previous Government.

Even though the CDU/CSU lost 8.5% of the vote compared to the 2017 federal elections, a coalition government with the participation of the CDU (24.5%), the Greens and the FDP would also be possible, although less likely due to the stronger orientation of the Greens towards the SPD's programme shown in the run-up to the elections.

What impact will the election have on the security and defence policy of the Federal Republic of Germany?

"For us it is clear that we can only fulfil our tasks as a reliable partner in Europe and NATO with a well-equipped and modern Bundeswehr," the SPD's election manifesto reads. There will certainly be no major changes, but it is well known that the SPD is critical of the use of armed drones – a demand of the military – even before it became known that numerous civilians, including children, were killed by a US military drone in Afghanistan in late August. The SPD supports the use of unarmed drones and advocates an international set of rules to counter the uncontrolled spread of these weapons systems.

In terms of foreign policy, the SPD is committed to a world without nuclear weapons. Against this background, Germany's so-called "nuclear sharing" is also put up for discussion, but not strictly rejected. "Before a decision is made on a successor to the TORNADO fighter aircraft, we advocate a conscientious, objective and careful discussion of technical nuclear sharing," the election manifesto states.

According to an assessment by the German think tank SWP, the new German Government will have to become much more involved in the crisis areas in the Middle East in order to counteract uncontrollable refugee movements. Against this background, an intensification of diplomatic relations with Iran is also expected.

Essential demands of the Left Party, regardless of whether it will be part of the new Government or not, will almost certainly not be met: the dissolution of NATO in favour of a new security alliance including the Russian Federation and the total renunciation of foreign deployments of the Bundeswehr, even if the latter certainly require a renewed, critical analysis after the debacle of the Afghanistan debacle. This is also in view of the fact that Afghanistan has once again shown that the German armed forces and those of other nations are not capable of acting autonomously in such missions, but are dependent on US support.

Nevertheless, Germany will remain a reliable partner in the international alliance structures and will continue to pursue a moderate foreign and security policy.

Jürgen Hensel

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Firms & Faces

EUNAVFOR MED IRINI: New Operation Commander Appointed



(jh) The European Council appointed Rear Admiral Stefano Turchetto as EU Operation Commander for the European Union military operation in the Mediterranean (EUNAVFOR MED IRINI). He took command from Rear Admiral Fabio Agostini on 1 October 2021.

Rear Admiral Turchetto has more than 35 years of experience in the Italian Navy. During his last assignment as First Naval Division Commander he had been for four different times "Operazione Mare Sicuro" Tactical Commander, operating in the Central Mediterranean Sea.

Previously, he had been Force Commander of EUNAVFOR Operation SOPHIA from September 2018 to June 2019.

EUNAVFOR MED IRINI was launched on 31 March 2020, shortly after the Berlin Conference on Libya in January 2020, as a concrete contribution on the part of the EU to the process set up by the international community to support the return to peace and stability in Libya. Its current mandate runs until 31 March 2023.

Benedict Willumsen Grieg Takes Up New Role

(jh) Kongsberg Digital has announced the appointment of Benedicte Willumsen Grieg to the newly created position



of Vice President, Strategy. Willumsen Grieg will be part of the management team, reporting to Hege Skryseth. Her objectives include the support of the company's further growth, with a spe-

cial focus on strategy projects and operationalisation, closely linked to strategic partnerships and acquisitions.

Willumsen Grieg previously held the post of VP Business Development in Kongsberg Digital's parent company, the Kongsberg Group, where she led and supported acquisition and strategy processes across the group's business areas. She took up the new position on 1 October.

Hensoldt and L3Harris Sign Cooperation Agreement

(gwh) (lah) German sensor specialist Hensoldt and L3Harris Technologies from the US want to jointly develop new capabilities for NATO's Alliance Future Surveillance and Control (AFSC) programme. To this end, the two companies have signed a strategic cooperation agreement to pool their expertise in the field of platform-independent mission solutions, Hensoldt writes in a statement.

Under the cooperation, Hensoldt will contribute capabilities in active and passive sensors, sensor data fusion and network management, among others.

According to L3Harris, the two companies' team will explore open systems, multi-function solutions and data-centric concepts as part of its system-of-systems approach. The aim is to improve the military capabilities of the NATO alliance by 2035 and beyond, it said.

ESG and Saab to Cooperate

(gwh) ESG Elektroniksystem- und Logistik-GmbH and Saab Deutschland GmbH have signed an agreement for strategic cooperation on equipment projects and development programmes for the German Navy, according to a joint press release.

Just a few days ago, Saab, as the prime contractor for the modernisation of the German F123 frigates, commissioned ESG to provide comprehensive logistics services to bring the new systems to operational readiness, pointing out that the agreement would take cooperation to a new level. In order to ensure the successful fulfillment of the German Navy's mission in the face of an increasingly complex and challenging security situation, it needs operationally ready, mission-robust and resilient naval systems with high-technology solutions and comprehensive technical and logistical support throughout their service life, the companies write.

InVeris Acquires Survivr

(jh) InVeris Training Solutions has announced that it has acquired Survivr, a privately held, Dallas-based public benefit corporation devoted to public safety. With the addition of Survivr to readiness training solutions portfolio, InVeris intends to continue to build on its commitment to deliver effective, reliable, and innovative products and services for when split-sec-



ond decisions matter, according to a press release from the company

InVeris' BlueFire simulated weapons technology with Survivr and InVeris' VR-DT virtual reality de-escalation and safety training solutions are to form a new generation of immersive, 3D, scenario-based training. Similarly, instructors can use dynamic branching for a wide range of responses based upon the trainee's verbal statements and physical actions.

Sandra Jung Becomes CSO at PLATH Systems & Integration



(jh) Sandra Jung has taken over the management of PLATH GmbH & Co. KG's worldwide sales activities. As new Chief Sales Officer (CSO) for PLATH Systems and Integration, effective

from 1st July 2021, Jung strengthens the management board of PLATH GmbH & Co. KG.

Jung has been in charge of PLATH Group's sales across Germany since 2018. Prior to this, she held various management positions for large companies. Her main areas of expertise include international business development, strategy and marketing. Ms Jung builds on around 15 years of experience in the industry.

Arqit and Babcock Sign Collaboration Agreement

(jh) Babcock International Group has entered into a collaboration agreement with Argit



Limited, a company specialising in quantum encryption technology. The agreement will see the

two companies jointly test and experiment with a range of use case scenarios and practical applications for government and defence customers to demonstrate the encryption capabilities of Arqit's QuantumCloud product. It will also see Babcock deepen its involvement in areas of broader Quantum technology development.

QuantumClou creates software encryption keys, combining patented quantum and classical technologies. According to Babcock, the product is simple and efficient to use at any cloud, edge, or end point device with no disruption to hardware or software required.

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Italy in Search of a New Infantry Fighting Vehicle

(gwh) The Consorzio IVECO-Oto Melara (CIO) with OTO Melara, Fiat and Iveco has presented a 3-D digital design image of the infantry fighting vehicle envisaged for the Italian Armoured Infantry Combat System (AICS) programme. In an interview with Rivista Italiana Difesa, Claudio Catalano, CEO of Iveco Defense Vehicles, said that the AICS programme will require a



budget of approximately €6Bn for 679 vehicles, of which €2.1Bn have already been allocated for the period until 2035.

As part of a modernisation programme, Italy wants to adapt its combat vehicles to the requirements of the modern battlefield and equip them accordingly. First modernisation measures have already started with the procurement of wheeled armoured vehicles such as CENTAURO II, FRECCIA and the Light Multirole Vehicle 2 (LMV 2).

For the DARDO infantry fighting vehicle and the ARIETE main battle tank, the designs of which date back to the 1980s, suitable solutions are being evaluated. In response to these modernisation efforts being urgent requirements, talks have already taken place at the highest level to seek timely solutions. In April 2021, the Italian Minister of Defence, Lorenzo Guerini, visited the German Ministry of Defence and Rheinmetall to discuss possibilities for cooperation. The LYNX KF41 infantry fighting vehicle was considered as a potential solution.

With the participation of Greece and Slovakia, and led by Italy, the LYNX could also be included in the PESCO project to develop a combat vehicle.

GA-ASI SeaGuardian Flies First Approved Point-to-Point UAS Flight in UK

(jh) According to information from General Atomics Aeronautical Systems (GA-ASI), the UK's Civil Aviation Authority (CAA) for the first time approved a point-to-point domestic flight of an unmanned aircraft that utilised the UK's airways structure when GA-ASI flew its MQ-9B SeaGuardian Remotely Piloted Aircraft (RPA) from Lincolnshire, England to Moray, Scotland on 12 September. The GA-ASI-owned RPA flew from Royal Air Force (RAF) Waddington to RAF Lossiemouth and the SeaGuardian flight was controlled by NATS, the UK's civilian Air Navigation Service Provider.

PROTECTOR RG Mk1 is the RAF's designation for the RPA they have ordered from GA-ASI; it is based on the MQ-9B. The GA-ASI-owned, civil-registered aircraft that made this flight is operating from RAF airfields as part of an ongoing set of demonstrations being conducted by GA-ASI for the RAF.

According to NATS, the flight took place through more complex airspace than any previous UAS flights in the UK. Among the capabilities on display is GA-ASI's Detect and Avoid (DAA) system, a safety and situational awareness enhancement designed to support PROTECTOR's flight in non-segregated UK airspace, as well as the platform's capability to integrate into broader European airspace. DAA is to enable PROTECTOR to operate amongst normal aviation traffic in the UK's national airspace. The demonstration flights are also assisting RAF Waddington, the future home of the RAF PROTECTOR Force, to prepare and integrate the new aircraft into its daily operations.



The demonstration continued until the end of September with the completion of exercise JOINT WARRIOR. The goal of the flight series has been to showcase MQ-9B's various operational capabilities, including the platform's maritime Intelligence, Surveillance and Reconnaissance (ISR), endurance, and interoperability with NATO partners. SeaGuardian is the maritime version of the MQ-9B SkyGuardian. The RAF has ordered 16 PROTECTOR RG Mk1 RPA systems as part of its PROTECTOR programme.

NATO Ships Return to Black Sea

(jh) According to a press release by the US Navy, Standing NATO Mine Countermeasures Group Two (SNMCMG2) units have



entered the Black Sea for the third time this year to conduct routine operations, including a port visit to Batumi, Georgia. SNMCMG2, consists of Spanish flagship ESPS RAYO, Italian ship ITS VIAREGGIO, and Turkish ship TCG EDINCIK. Romanian ship ROS LT. LUPU DINESCU and Bulgarian ship BGS SHKVAL will join the group after they enter the Black Sea.

According to the US Navy, the third SNM-CMG2 Black Sea deployment constitutes an important opportunity for interoperability and readiness enhancement with allies and partners. The deployment will include the port visits to Batumi, Georgia, after which there will be an exercise with the Georgian Coast Guard. The deployment will include a port visit to Samsun, Turkey.

With three Allied nations, Bulgaria, Romania and Turkey, and two regional partners, Ukraine and Georgia bordering the Black Sea, Standing Naval Group's presence in the region is a regular occurrence. While in the Black Sea, the group will also conduct maritime security patrols in international waters to enhance NATO maritime situational awareness between Allies and regional partners.

India Formalises Acquisition of 56 Airbus C295 Aircraft

(jh) Airbus has announced India's formalisation of the acquisition of 56 Airbus C295 aircraft to replace the Indian Air Force (IAF) legacy AVRO fleet. According to Airbus, this is the first 'Make in India' aerospace programme in the private sector, involving the full development of a complete industrial ecosystem: from the manufacture to assembly, test and qualification, to delivery and maintenance of the complete lifecycle of



the aircraft. In the scope of the contractual agreement, Airbus will deliver the first 16 aircraft in 'fly-away' condition from its final assembly line in Seville, Spain. The subsequent 40 aircraft will be manufactured and assembled by the Tata Advanced Systems (TASL) in India as part of an industrial partnership agreement between the two companies. The first 16 aircraft will be delivered over four years after the contract implementation. All the IAF C295s will be handed over in transport configuration and equipped with an indigenous Electronic Warfare Suite.

Bundeswehr FUCHS to be Upgraded by Rheinmetall

(jr) Rheinmetall has been awarded a Bundeswehr contract to modernise the FUCHS (FOX) armoured NBC reconnaissance vehicle. A total of five A6A1 versions of the vehicle will be upgraded to the new highly protected A8A7 configuration. The Bundeswehr will thus have at its disposal an NBC reconnaissance and analysis capability suitable for modern operational demands. Work began in September 2021



and is expected to be complete by July 2024. The German military will receive the first vehicles in early 2023.

The order has special significance for Rheinmetall's Kassel plant for two reasons. It strengthens the Group's centre of excellence for NBC systems technology, and thus safeguards valuable jobs in the north Hessian metropolis, which is also the birthplace of the battle-tested 6×6 fighting vehicle. Potentially, the order could also lead to the Bundeswehr's remaining 22 FUCHS vehicles being upgraded to the new A8A7 configuration, as well as proposals to modernise systems operated by international customers.

Bundeswehr FUCHS History

The Bundeswehr has fielded numerous versions of the FUCHS since 1979, deploying over a hundred of them in Afghanistan. Owing to its versatile operational possibilities and high reliability, the FUCHS has always been popular with the troops. After over 40 years in service, it is still undergoing continuous improvement.

Its latest version – the FUCHS 1A8 – offers greater protection against mines and IEDs and enhanced resistance to ballistic threats. Among the principal modifications featured in the FUCHS 1A8 are:

- Structural alterations of the hull
- New seats and seat suspensions in the fighting compartment decoupled from the floor of the hull
- Reinforcement of the wheel wells
- Doors and window mounts
- Additional storage bins and reinforcement of the vehicle exterior

The Bundeswehr now has over 940 FUCHS vehicles in its inventory, 267 of which are the latest 1A8 design.



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Last Argentine OPV Launched

(jh) Naval Group has announced that the last of the four Offshore Patrol Vessel 87 (OPV 87) ordered by the Argentinean Navy, ARA CONTRAALMIRANTE CORDERO, was launched on 21 September in Concarneau. This forms part of the contract signed in 2018 to provide four multi-mission OPVs. ARA BOUCHARD (ex-L'ADROIT) had been delivered in December 2019 and ARA PIE-DRABUENA on 13 April 2021. ARA STORNI was launched on 10 May 2021 and will be delivered next October, in accordance with the original contractual schedule.

The last vessel of the series will offer the same assets and characteristics as the ARA



PIEDRABUENA and STORNI. It benefits from an optimised motorised system, an active stabilisation system and a bow thruster. It is also "ice proven", meaning it is adapted to navigate the cold waters of Antarctica. According to Naval Group, the Argentinean OPVs feature technologies sea proven by the French Navy, which has operated L'ADROIT for six years for multiple maritime security operations, including:

- high endurance
- good sea-worthiness
- an innovative design
- 360° visibility from the bridge
- a unique mast for a panoramic radar coverage
- discrete and safe deployment in less than five minutes of fast craft for special forces
 ARA CONTRAALMIRANTE CORDERO is

equipped with the POLARIS command and weapon control system and NiDL tactical data link system.

Naval Group asserts that the OPV is able to accommodate a helicopter and a reduced crew of 40 members in addition to twenty extra passengers.

- Length: 87 metres
- Beam: 14 metres
- Displacement: 1,650 tonnes
- speed: over 20 knotsAccommodation:
- 59 (crew and passengers)
- Endurance: > 7,000 nautical miles
- Boarding capacity: two light crafts of 9 metres and one 10-ton class helicopter

Russian Army Adopts Rostec's Ordnance for Protection against High-Precision Weapons

(jh) A new obscurant ordnance developed by the Central Scientific Research Institute for Precision Machine Engineering (TsNII-TochMash) of the Russian Rostec State Corporation has been accepted for service by the Russian Armed Forces. The product has been designed for individual protection of vehicles against high-precision weapons with laser, optical and thermal guidance systems.

When a threat arises, the 3VD35 protective ordnance is fired in the direction of the threat and creates an aerosol screen that "fools" the enemy's precision-guided munitions guidance systems.

The calibre of the ordnance is 76 mm, with a length of 290 mm and a weight of 1.8 kg. The temperature range of the ammunition is from -50°C to +50°C.

Rohde & Schwarz Radios for Canada

(gwh) The Canadian Department of National Defence has contracted Rhode & Schwarz to supply HF radios over the next five years. According to the company, existing radios at strategic locations of the Royal Canadian Navy, the Canadian Army and the Royal Canadian Air Force will be replaced with modern radios from the SOVERON series.



According to the press release, RF receivers of the R&S M3SR Series4100 family will be supplied, which are part of the already introduced SOVERON radio family. The advanced radio systems take RF communications to the next level and support future capabilities such as RF wideband. It is a powerful radio platform that can be expanded at any time, the company added.

New DNV Naval Technical Assurance Concept

(jh) Classification society DNV has released the new Naval Technical Assurance Certification Concept, as an alternative approach to the classification assurance process. The new concept is set down in



the DNV-SE-0555 Naval Technical Assurance Service document, published on 25 August 2021.

The regulation of naval and occasionally governmental vessels is significantly different from merchant vessels and requires more diversified and broader assurance processes. Combining DNV's competence in naval surface, subsurface and governmental vessels, naval technical assurance is an overarching service for naval vessels, enabling DNV to adjust the assurance scope to provide customers a service tailored to their requirements.

Under the umbrella of Naval Technical Assurance, DNV offers verification according to a variety of different standards, which may be flexibly combined with DNV's classification portfolio. These standards include:

- National legislation prescribing clear safety objectives and/or a regulatory system;
- Detailed navy proprietary regulatory systems, in some cases combining this with a clear safety objective;
- Regulatory systems mainly relying on Classification Society services;
- Regulatory systems applying NATO's ANEP-77 Naval Ship Code as the main means of material safety and seaworthiness control.

This results in a customised service from the first concept of a new vessel, through design, newbuilding, operation, and endof-life.

DSEI 2021: Team THUNDER Launched

(jr) Hanwha Defense launched its Team THUNDER partnership at DSEI 2021 in a bid to supply the British Army with a next generation howitzer.

The team includes industry from across the UK with names such as Pearson Engineering, Leonardo UK, Horstman Defence Systems and Soucy Defense.

If successful, this would be the first sale of the improved K9 THUNDER A2 variant which has new features including greater automation with the crew reduced from five to three. According to the company, this would be: "a real made in the UK solution." On the second day of the event, an agreement was signed between Hanwha and Soucy Defense which would bring the latter's composite rubber track technology to the K9.



The K9 THUNDER is already operated by the Republic of Korea Army and export customers including India and Estonia. An outline business case for the bid will be submitted early next year before an invitation to tender is issued. Hanwha's stand also featured models of

the REDBACK IFV being marketed to Australia and examples of the BIDO self-propelled gun and missile air defence system. Another exhibit was a model of the nextgeneration autonomous UGV for infantry which can be configured for a wide variety of roles.

DSEI 2021: THeMIS Combat UGV Unveiled

(gwh) Hornet, the French developer of Remote Controlled Weapon Stations



(RCWS), which is part of Arquus, and Milrem Robotics, the Estonian developer of UG-Vs, jointly unveiled the new THeMIS Combat UGV at the DSEI 2021 exhibition in London.

According to a statement from Arquus, the system consists of Milrem Robotics' THeMIS UGV and the Hornet RCWS. The Hornet RCWS was developed for the new French 4×4 and 6×6 armoured combat vehicles of the SCORPION programme, but also offers functions for UGV applications. According to Arquus, THeMIS is equipped with intelligent functions such as:

- Waypoint navigation
- Follow-me

• Obstacle detection and avoidance The intelligent functions are used only for mobility and the RCWS is controlled by a human. These have been developed according to the precision and first-shot hit probability requirements of the French Army.

DSEI 2021: MISSION MASTER with BRIMSTONE Presented

(Ih) At DSEI in London Rheinmetall unveiled the MISSION MASTER XT UGV combined with a fire support module featuring MBDA's BRIMSTONE missile. According to Rheinmetall, BRIMSTONE can be used against a wide range of targets, including MBTs. The missile, which has already been introduced to the British Armed Forces, can be used both in line-of-sight and non-lineof-sight against stationary and moving targets, according to the manufacturer. Volley fire is also possible.

According to Rheinmetall, the MISSION MASTER XT base vehicle can easily master difficult terrain and is also buoyant. The diesel engine allows a range of 750 km on a single tank of fuel, while lithium-ion batteries ensure silent guard operation for up to six hours.



The UGV is controlled by Rheinmetall's PATH autonomy equipment. This enables manned-unmanned teaming concepts by enabling the crews of armoured combat vehicles such as the CHALLENGER, LYNX or PUMA to control the MISSION MASTER.

Hensoldt Unveils QUADOME Radar

(Ih) AT DSEI, German sensor manufacturer Hensoldt unveiled a new radar system for maritime surveillance and target acquisition. The radar is named QUADOME and implements latest technologies, according to the manufacturer, who asserts that it offers fast response and high precision at an excellent price-performance ratio.

Operating in the C-band, the radar features gallium nitride technology with an active electronically steered antenna and



is software-defined. According to the manufacturer, QUADOME targets the global market for tactical naval radar systems aimed primarily at offshore patrol vessels, corvettes, light frigates and support vessels.

Hensoldt further states that QUADOME offers "robust capabilities" for detecting and tracking small surface targets, as well as precise 3D tracking of small, low-flying and fast-moving aerial targets. The radar was reportedly developed and will be produced at Hensoldt in South Africa. As a result, the technology is not subject to US or German export controls. According to the company, there is no launch customer at the moment though talks are being held with several interested parties.

QUADOME's compactness, relatively low mass and price-performance ratio offer 3D air surveillance and air defence capabilities for ships that would otherwise only be equipped with 2D target acquisition capabilities.

The radar has two main modes of operation. Surveillance mode is used for general ground and air surveillance, while self-defence mode is used for high threat and target engagement situations.

Establishment of the Franco-German C-130J Wing

(gwh) With the signing of the second intergovernmental agreement on Franco-German cooperation in the field of air transport, the German and French Defence Ministers, Annegret Kramp Kar-



Photo: Bundeswehr.de

9

renbauer and Florence Parly, cleared the last hurdle for the official founding of a joint Franco-German wing in September. As the German MoD has announced, the core of the project is the creation of a binational wing and a training centre at the Évreux air base. The bi-national tactical airlift fleet began was launched in 2016 and is intended to strengthen the interoperability of the two armed forces.

Ten C-130J transport aircraft will be operated by mixed German and French crews. France has already received its four C-130Js and the first German aircraft will soon take off on its maiden flight and will be delivered in early 2022.



For the other five, delivery has been agreed by the end of 2023. Initial operational capability is to be achieved in autumn 2021 with the installation of the unit in Evreux. Full operational capability is to be achieved in 2024.

FN Herstal Machine Guns for Norway

(jr) The Norwegian Armed Forces have placed an order with FN Herstal for new machine guns. A two-part framework contract for this was recently awarded according to a notification from the Norwegian procurement agency Forsvarsmateriell (FMA).

The first contract has a duration of seven years and provides for the delivery of up to 4,000 FN MINIMI 7.62 Mk3s with logistical support. A second contract governs the procurement of spare parts, accessories, special tools and training services, which is for a period of 20 years. The framework agreement is worth up to \leq 35M.



The FN MINIMI 7.62 Mk3 is a development of the light machine gun from FN Herstal in 7.62 mm x 51 calibre. It was first introduced in 2013 and is in use with over 40 nations, including NATO countries Belgium, France, the UK and the Netherlands.

The main changes of the MINIMI Mk3 were aimed at ergonomics and manoeuvrability, while the core system was retained for easier logistics.

Improvements to the Mk3 include:

- A length-adjustable shoulder rest (five detent positions) with integrated buffer and adjustable cheek rest;
- A redesigned hand guard to which the height-adjustable bipod can be folded, even when accessories are mounted;
- A more ergonomically designed tension slide;
- An improved belt feed;
- An optional heat shield;
- A conversion option of the FN MINIMI 7.62 Mk3 to be able to fire 5.56 mm x 45 calibre ammunition.

Fifth MMU MRTT Delivered

(gwh) The fifth A330 based Multi Role Tanker Transport (MRTT) aircraft for NATO's Multinational MRTT Unit (MMU) has been available for operations at its main operating base in Eindhoven since 31 August, the NATO Support and Procurement Agency (NSPA) has announced. The previous day, this aircraft was handed over by Airbus to the NSPA, which manages the fleet for the MMF nations, via the European OCCAR armament agency.



Belgium, Germany, Luxembourg, the Netherlands, Norway and the Czech Republic are financing the procurement of nine designated transport aircraft, which will be based with the MMU at Eindhoven and Cologne. Delivery of the A330 MRTTs began in June 2020. After training of personnel, flight operations began in May 2021 with the transport of a Luxembourg contingent to the EU support mission in Mali. This was followed by a mission on behalf of the Czech Republic and participation in the evacuation of military personnel and civilians from Afghanistan.

The NSPA also announced that the MMF's sixth and seventh aircraft are currently in various stages of their MRTT conversion at the Airbus facilities in Getafe, Madrid, and will be delivered to the MMU in February and July 2022.

Latvia Orders 200 6x6 APCs from Patria

(gwh) At the end of a nearly two-year joint development phase, Latvia signed a framework agreement with Finnish vehicle manufacturer Patria for joint procurement management and a contract for the delivery of 200 6×6 protected crew transport vehicles, according to the company.

The information states that the first vehicles will be delivered this year while deliveries are scheduled to end in 2029. The delivery contract also provides for the equipment of sup-



port and training systems. The Latvian/Finnish development and procurement project is open to the participation of other countries, Patria quotes from the agreement.

According to Patria, the 6×6 vehicle combines all the proven features of the Patria XA and AMV vehicles. It is simple, reliable and designed to meet the highest demands of customers. Its off-road capability is ensured by an efficient drive unit and the independent suspension familiar from Patria's AMV vehicle. Thanks to the spacious interior and clearly defined functions, the vehicle is easy to operate. It can be adapted to different operational needs and offers high versatility. The vehicle is based on Patria's proprietary 6×6 vehicle, which was first introduced at Eurosatory 2018. A diesel engine with 294 kW of power and a torque of 1,870 Nm, as well as the independent suspension familiar from the AMV, are the basis for the 24-tonne vehicle's high off-road capability. Protection against ballistic and explosive threats can be implemented between level 2 and level 4 according to STANAG 4569, depending on the requirements.

In addition to the driver and commander, there is room for up to ten soldiers with their equipment for a 72-hour mission, depending on the mission equipment. The vehicle concept is designed to be equipped with a manned turret.

Russian Air Defence Systems Used in Syria

(yl) According to Russian media, 22 Israeli missiles were recently intercepted by Syrian air defence forces. The missiles were reportedly launched from Israeli combat aircraft in



Lebanese air space on 19 August. The report quotes Admiral Vadim Kulit, Deputy Head of the so called Centre for the Reconciliation of Warring Parties, as the source of information. The Syrian military and facilities remained unharmed, said the Admiral.

The Syrian air defence systems of Russian origin involved include the BUK-M2E of Almaz-Antey and PANTSIR-E of the Shipunov KBP Design Bureau, now part of the High Precision Weapons Holding.

According to SIPRI, 36 units of the PANTSIR 96K6 export version with 700 9M311 missiles were delivered to Syria between 2008 and 2011, followed by 18 units of the 9K317E BUK-M2E in the same year.

SECURITY POLICY

The Current Terrorist Threat in the United Kingdom

Andreea Stoian Karadeli

September 2021 marked 20 years of war against terrorism and the moment a historic cycle closed. The image of the US plane (1109) leaving Afghanistan in August 2021 carries the symbolism of a numbers game sending a powerful message not just to the American people, but to all its Western allies. The 9/11 aftermath is now over, and this is the time for a strategic change and for the development of a new approach in the fight against terrorism.

Just like the United States of America, the United Kingdom will remain one of the key players in the new round of, evidently, the same game.

The terrorist threat has evolved into a global, both physical and virtual, hard-to-follow, hard-to-predict or control phenomenon that knows no boundaries of geographical, cultural, linguistic, ethnic, ideological, or bureaucratic nature. Its main advantage remains its enhanced capacity to easily adapt to any context. Beyond the general characteristics developed by the global terrorist phenomenon, there is also a layer of individual traits for every country, based on historical evolution, national/regional and local circumstances. Adapting to both pandemic and post-pandemic reality, at the same time in a post-Brexit environment, the United Kingdom continues to be the target of many terrorist groups active on the ground. Unlike ever before, the lines between those groups are now blurred, leaving the chance for a symbiotic relation that makes the phenomenon even harder to control and defeat.

How has Terrorism Evolved in the UK?

The history of terrorism in the United Kingdom has always tended to transcend the

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London in terror alert in January 2015

narrow political and religious dimensions that have so far been associated with the phenomenon around the world. Some key moments in the evolution of the terrorist threat should be provided to serve as background for this assessment. While its historic roots lie much deeper, many believe that the Gunpowder Plot of 1605, an attempt to blow up the House of Lords carried out by Guy Fawkes and fellow Catholic conspirators represented the starting point of the terrorist threat in the UK. Later, England became an important hub for anarchist thought as a result of the less restrictive national laws that created a haven for radicals who faced political repression in their home countries. The bombing of Clerkenwell Prison in London in 1867 marked the presence of a different dangerous group, the Irish Republican Brotherhood, nicknamed the "Fenians" - a movement mostly observed in Canada and Ireland. The 1909 assassination of a British official on the steps of the

Imperial Institute in London by the Indian revolutionary Madan Lal Dhingra, sparked an anti-colonial wave of militant networks throughout India and Great Britain, while the most intrusive repercussions were felt by the Indian students present in the country. Probably the most discussed and analysed terrorist threat within the evolution of the phenomenon in the United Kingdom, the Irish Republican Army (IRA), was the movement that struggled against the British Government, resulting in systematic attacks that lasted until the late 1990s. While Belfast was at the heart of the fight, the IRA also conducted terrorist attacks in England, some of which were disastrous for the country.

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Current Trends

More recently, following the global trend, the UK has been facing the Salafi-jihadi threat, becoming one of the top countries

SECURITY POLICY



9/11 was a turning point in history. The repercussions of 9/11 can be seen in every corner of the world and every aspect of life.

affected by the evolution of this phenomenon. Although various forms of extremism have been witnessed after 2006, the international practitioner and scholarly focus has remained on Salafi-jihadist terrorism, creating a gap in research regarding the topic of violence and extremism from the extreme right and left, in particular, on target selection, perpetrators, patterns of action, and facilitating conditions. The current trend provides sufficient motivation for this gap to be filled, but there is still much work to be done and many elements of this phenomenon are yet to be understood as events are continuing to develop. Bearing in mind the increasing activity of the

right-wing and left-wing extremist groups around Europe and especially in the UK, the current terrorist threat should be assessed from all sides and ideologies. The "trinity of terror" - Salafi-jihadism, rightwing and left-wing terrorism - have been feeding on each other's propaganda, strategy and means, in a symbiotic relationship. Strategic enemies on the surface, the three become rhetorical allies through mutually reinforcing hate speech, using fear to divide communities and gain new members. The current terrorist threat in the UK has evolved beyond the general ideological classification, creating the need to use a different set of spectacles to understand the

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A flower memorial display on London Bridge following the terrorist attack of June 2017

generic and context-specific dynamics of the violent radicalisation among individuals and groups.

Law and Strategy

Similar to its European counterparts, the UK government has adopted a variety of legislative laws as part of its national strategy to prevent, combat and fight against terrorism and violent extremism. Among the main "legislative weapons" used by the UK Government, the "emergency laws" have allowed necessarily restrictive measures to be taken during difficult times against different terrorist actions. Some of the earliest emergency powers were used against the IRA from 1874 to 1989. As the threat evolved, the security measures have been packed by supportive legislation that, sometimes, in the long-term, indirectly gave way to resurrecting violence and hatred. Over the years, various laws and legislative acts have sought to expand on this original legislation to provide a better strategy to track and prevent terrorist attacks. Some of the main extended laws passed in the UK in the past twenty years are the Anti-Terrorism, Crime, and Security Act (2001), the Prevention of Terrorism Act (2005), the Counter-Terrorism Act (2008), the Terrorism Prevention and Investigation Measures Act (2001), the Counter-Terrorism and Security Act (2015), and the Investigatory Powers Act (2016, Snoopers' Charter).

Since 2003, the UK Government has introduced, developed, and updated the CON-TEST counter-terrorism strategy. This response to fighting terrorism is built upon an approach that unites the public and private sectors, communities, citizens, and overseas partners around the single purpose to leave no safe space for terrorists to recruit or act. The strategy proposed by CONTEST provides the framework that enables law enforcement to organise this work to counter all forms of terrorism. CONTEST's overarching aim is to reduce the risk to the UK and its citizens and interests overseas from terrorism, so that its people can go about their lives freely and with confidence. The strategy is composed of four central pillars: i) Prevent (to safeguard and support those vulnerable to radicalisation, to stop them from becoming terrorists or supporting terrorism); ii) Pursue (to stop terrorist attacks happening in this country and against UK interests overseas);iii) Protect (to strengthen our protection against a terrorist attack in the UK or against our interests overseas, and so reduce our vulnerability); and iv) Prepare (to mitigate the impact of a terrorist incident, by bringing any attack to an end

rapidly and ensure fast recovery). According to the 2018 report of CONTEST, an updated and strengthened version of the strategy continues with the tried and tested framework of the four work strands. An in-depth review of the counter-terrorism approach found that this structure remains effective and continues to guide the planning and work of many agencies and departments in the UK. In this regard, the purpose of Prevent and Pursue remains to reduce the threats faced by the country, while the purpose of Protect and Prepare work is to reduce its vulnerabilities. Still, despite the fact that the historical evolution of terrorism has forced the UK to face various types of terrorism, the counter-terrorism agenda has been largely focusing on the Salafi-jihadi threat, aligning its framework to the global trends of national security and war on terror. As a result, the response to the terrorist threat reinforced a malign cycle of violence, hatred, and stigma that have not benefited any side.

Terrorist Threat in 2020-2021

Recently lowered to "Substantial", the current terrorist threat to the UK remains real and undeniable, assuming that an attack is currently "likely" to happen. Bearing in mind the current situation in Afghanistan, and the fact that events at home are often inspired by those far away, the threat is expected to rise once again in relation to the evolution of events developing outside of UK's borders. In other words, the threat level is designed to be a dynamic decision, reflecting both the international and domestic security situation, while rising and falling with some regularity asand-when things change. The UK threat level is set by the Joint Terrorism Analysis Centre, known as JTAC. According to its mission statement, JTAC "brings together counter-terrorist expertise from the police, and government departments and agencies so information is analysed and processed on a shared basis" (JTAC website). Based out of MI5's headquarters at Thames House in London, they are operationally independent from politics, government and the intelligence agencies.

Ethno-Nationalism and Separatism

At this point in time, threats from terrorism have shown an evolving and shifting pattern in the UK. The oldest forms of domestic terrorism, the ethno-nationalist and separatist terrorism, in the Northern Ireland context, although operating under a different nature, are still ongoing with the New IRA. Recent cross-cutting events such as the global pandemic and lockdowns, Brexit, the FTF phenomenon and the returnees, the radicalisation of young people in various settings, especially the prison environment, the online domain, and now, the Afghanistan context, have encouraged a dramatic rise of various types of terrorism, including right and left-wing extremist groups that invoke the "us vs them" narrative.

According to the latest information released to the public by the UK's principal domestic security agency, MI5, the "toxic" issue of racism is fuelling a growing threat from the far right, reaching and radicalising through the online environment teenagers as young as 13. While far-right terrorism has been described as the UK's fastest-growing threat, in 2020, MI5 stated that investigations into left-wing terrorism would be conducted for the first time. However, the government stressed that the threat level from left-wing terrorism was relatively small compared to Islamist and far-right extremism. In the last four years, 10 out of the 29 attack plots disrupted in the UK were related to the extreme right-wing. Far-right attacks in the UK have not resulted in mass casualties





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but have instead caused individual casualties, usually via stabbings or by driving into crowds of people, its wider threat comes from the ability to influence and convert young people to a twisted and violent narrative. Moreover, during 2020, EU Member States reported a total of 57 completed, failed, and foiled terrorist attacks, while the United Kingdom alone reported a total materials, feeding on mainly similar, but context-adapted twisted extremist narratives. As observed through the numbers, the terrorist threat remains high, and it is now more diverse and dispersed. The new trends make it harder to identify a pattern of radicalisation or to be able to track individuals who might be connected to a certain terrorist network. While there



At a vigil after the 2017 London Bridge attack, British Muslims show their empathy and support for the victims.

of 62. This represented a slight decrease from the preceding year when the number of terrorist attacks completed, failed, and foiled in the United Kingdom in 2019 was 64. In 2020, a decrease was also observed among the terrorist arrests within the EU and UK: 449 in EU Member States and 185 in the United Kingdom. Still, it is unclear whether this indicates reduced terrorist activity, or is a result of changes in the operational capabilities of public authorities during the pandemic. As the number of Salafijihadi attacks has increased since 2019, EU Member States and the UK have witnessed a higher number of completed Salafi-jihadi attacks (ten for the EU, three for the UK) than thwarted attacks. This represents a dangerous trend that should be addressed. Furthermore, radicalisation in the prison environment and the issues of returnees from war-zones around the world continue to be key topics in the continuous development of a counter-terrorism strategy for the UK, and elsewhere.

The virtual global terrorist phenomenon puts added pressure on the authorities to map, profile, and track the perpetrators and the networks that continuously develop using the diverse pool of opportunities offered by the digital world. Moreover, the blurred lines between the main ideologies, Salafi-jihadi, right- and left-wing, are overlapping through the common elements they use in their online propaganda is an increasing need for protection and surveillance in the online environment, we must ensure that we reach people who are susceptible and sensitive to extremist material before a terrorist group does. As lockdown and social distancing measures are now being relaxed, the UK Government is promoting greater use of open public spaces to try to kick-start the economy while keeping transmission of the virus low. Bars, cafes, restaurants, and entertainment venues can more easily apply for "pavement licences" to place tables and chairs in public spaces outside their premises. While this response is likely to benefit businesses and the economy, there's a real risk these new outdoor arrangements may become attractive targets for terrorists. The UK's recovery strategy mentions redesigning public spaces to make them "secure", but only focuses on the risk of the virus itself. Security also needs to take into consideration the threat posed by terrorism.

The current situation in Afghanistan might also represent a potential danger of Salafi-jihadist terrorist groups trying to rebuild their capabilities and re-establish some training facilities like the ones seen in the past. Although it does not imply a direct immediate threat to the UK and other western countries, the withdrawal from Afghanistan represented a "morale boost" to the Salafi-jihadi movement and a 'gain' for their narrative. Therefore, the possibility of an attack being perpetrated in the future is high and the authorities need to be alert. As observed through the numbers, the terrorist threat remains high, and it is now more diverse and dispersed than before. The new trends make it harder to identify a pattern of radicalisation or to be able to track individuals who might be connected to a certain terrorist network.

What Should Be Done?

Firstly, it is important to underline that the United Kingdom needs to learn from the past and implement effective and just policies that do not discriminate against specific members of its population, with trust building and cooperation as key elements, to "evolve" and successfully prevent terrorist attacks. Secondly, while there is an increasing need for protection and surveillance in the online environment, we must make sure that we reach people who are susceptible and sensitive to extremist material before a terrorist group reaches them first. Moreover, the global pandemic has kept people at home and opened them up towards a virtual reality. The vulnerability of younger people to extreme ideology is worrying, and it is highly likely that against a backdrop of populism and economic stagnation, right-wing extremism will continue to grow in Europe and in the UK also. But that doesn't mean that we have the luxury to repeat the mistake of focusing on just one ideology, while underestimating the potential of the others. Therefore, the current strategy should be developed not only regarding treating all these threats equally, but also to develop the ability to adapt and respond to the symbiosis between terrorist groups from different ideologies. Thirdly, any future strategy should be based on a comprehensive understanding of the thought processes and conditions that lead people to choose to join a violent extremist group and eventually, become the perpetrators of a terrorist attack. To deal with this problem in the longer term, we must understand these underlying issues and deal with them. And this stage can only be achieved through a strong commitment from people working in the field, scholars, and communities at risk. Last, but not least, we all need a change of perspective that should begin from here: violence leads to violence, and we only reap what we sow. The next round of this game should bring new rules to the table to ensure that past mistakes are never repeated, because the price for this only becomes higher each time.

Camouflage Solutions – Challenging all Battlefield Sensors

Camouflage, concealment and deception has always been an important capability, but today, with the exponential development of technology making drones and sensors accessible for everyone, it has become more important than ever. CCD is today a prioritised capability for all western countries, and by having the right equipment, units will increase their chances of staying alive and fulfil their missions.

Armed forces are aware of the challenge and they are looking at how the key capability of camouflage and deception can be best and most effectively provided and developed in the future. Saab Barracuda offers advanced camouflage solutions for all known sensors used on the battlefield today. It offers troopintegrated, soldier-integrated and platformintegrated solutions for static and mobile operations.

Protection on the Move

Saab Barracuda's advanced Mobile Camouflage System (MCS) is intended primarily for protection of military vehicles during moveThe Saab Barracuda advanced Mobile Camouflage System is optimized in colour, design and properties can be quickly adapted to any mission and theatre of operations. Barracuda MCS provides simplified logistics and the vehicle can be prepared for training or any mission in any environment in hours without repainting or mounting complex add-ons as extra air conditioning.

ULCAS for all Environments

To complement the CCD capability in mobile operations, Saab has designed the ULCAS (Ultra-Lightweight Camouflage Screen)

Customised and Cost-Efficient

ULCAS is cost-efficient, making conventional multiple and single-layer camouflage for different requirements virtually redundant. The non-snagging properties also dramatically increase its service life compared to conventional camouflage.

When developing the multispectral camouflage system ULCAS, it was of particular importance that soldiers would be protected in any environmental situation when executing their mission. The best way to meet the customer's requirements and expectations and develop world-class camouflage as a result is to unite with the customer.



Saab's MCS in desert camouflage.

ment and in combat and helps the vehicle to blend in with the surroundings. MCS is a flexible solution, which can be applied in several configurations using different types of materials. It provides protection against sensors, camouflage capability in the visual, near-infrared, short wave infrared, thermal infrared spectrum and broadband radar wavebands, dimming sensors, obscures targeting and fooling smart ammunition and offers a tactical and operational advantage. MCS is essentially a tailor-made, multi-purpose combat system enhancing survivability and sustainability of a vehicle or platform in a specific operational environment and in response to the respective requirements.

The ULCAS system has been designed to protect static objects.

camouflage system for static operations, which is also multispectral. Saab's Barracuda ULCAS has all the properties needed in one piece of net. It is very light - 250 grams per square metre – meaning soldiers can easily carry 50-75 square metres when needed. With a 3D surface structure, the net is flexible and easy to install. ULCAS is the leading multispectral camouflage net with unrivalled signature protection for vehicles and other objects in static positions. These multispectral properties protect against reconnaissance and sensors working in the ultraviolet, visual, thermal infrared, shortwave infrared, near-infrared and radar aspects of the electromagnetic spectrum.

To do this, Saab visits the intended terrain with the customer to see how the troops and vehicles behave in the particular environment.

Saab's advanced camouflage technology products have been exported to more than 45 countries. Saab offers a unique package of camouflage systems and force protection solutions developed to limit an enemy's ability to detect and engage. Various solutions and configurations are available to protect camps, vehicles as well as individual personnel in any type of terrain or environment.

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Naval Industrial Alliances in Europe

Giulia Tilenni

Increased competition from big Asian shipyards should have convinced European shipyards that integration is crucial to maintaining their leading role on the international market. Instead, they still seem keener to think national than international, thus indirectly favouring non-European competitors while putting their own survival at risk.

or several years, European shipyards have been able to preserve their leading role in the global market thanks to two main features. First, possessing both civilian and military shipbuilding capabilities maintains the supply chain and provides the diversification needed to better overcome crisis periods. Second, the ability to guarantee high guality standards and to feature cutting-edge technologies, especially in the most complex segments such as aircraft carriers and multi-purpose frigates, has been an asset so far. Hence, European shipyards have achieved remarkable export results (about 40 per cent of the entire production) in the military sector, in which competition is not the norm. However, technical capabilities and good market strategies are no longer sufficient to remain competitive in a changing market, driven by the new impetus given to military fleets worldwide. While the need for building up modern military navies emerged abroad, and particularly in Asia, investments on the modernisation remained limited among European navies. The fact that the Chinese naval fleet will become the world's biggest in 2030 while Europeans are still recovering from decades of scarce economic investments demonstrates the different levels of ambition.

Despite the fact that investments are slowly resuming, the number of large European programmes, such as the Italian Legge Navale for the development of Pattugliatori Polivalenti d'Altura (PPA, Multipurpose Offshore Patrol Vessels) and the programme for the design of the future French aircraft carrier, remains limited in numbers and frequency. The increased number of non-European customers might have been good news for European shipyards, as it could

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A model of Fincantieri's FREMM design

open new market opportunities abroad. However, Asian countries have preferred to invest in the modernisation of their national shipyards, thus closing the gap with European companies, rather than buying abroad. As China, Japan and South Korea have become competitors on existing market segments rather than new potential markets, Europe-based shipyards might not be able to win enough bids to maintain their leading position in the military naval sector.

Aggregation

The protection of the technology edge remains crucial to maintaining competitiveness in the face of emerging actors. Populated by small and medium-sized companies, the European shipbuilding sector is more fragmented than the Asian one, which mainly relies on giant-sized shipbuilding projects. This has created a situation leaving little room for economies of scale in a context already affected by higher labour costs and work safety rules, with a consequent reduction of the competitive edge. Asian-style M&A may be a viable option to reverse this trend, as aggregation per se would benefit integrated shipyards. But obstacles to successful integration are numerous and diverse, such as:

- The lack of common geopolitics and shared military ambitions. The fact that different strategic ambitions result in different operational requirements and preferences for national companies/ products typical of the defence market are major sticking points. FREMM frigates in service in the French Marine Nationale and in the Italian Marina Militare are a notable example: a project intended to be European, and thus developed within the OCCAR framework, and that finally ended in two utterly different vessels, with significant market implications.
- The coexistence of different corporate structures, which determines the company's strategy and end state. While industrial objectives are mainly profitoriented for private ventures such as Damen, political objectives such as job preservation and local development are key in the strategies of state-owned companies such as Navantia, Naval Group, or Fincantieri.
- The different international activities developed by each company. The existence of joint ventures and holdings, and

mixed collaborations in the military and the civilian sector complicate the establishment of a European-wide regulation of COTS components for military products. As an example, Fincantieri owns the US-based Marinette production site for the military sector and collaborates with China State Shipbuilding Corporation (CSSC) in the civil sector.

Enabling integration would require each shipyard to make sacrifices, for instance in terms of jobs and management. In fact, shipyards continue to work towards maximising their profits and strengthening their own market positions, even when this implies fierce competition with other European yards. In other words, companies prefer to go it alone rather than going European despite the increasing calls for integration, which are also included in programmatic documents of European institutions. The negative consequences of these choices are already visible.

Integration: How not to Do It

Losing national competitions and foreign bids are probably the most relevant failures stemming from the lack of aggregation. The German bid for multi-role combat ships (MKS 180) and the history of Naviris, Fincantieri's and Naval Group's 50/50 joint venture, are relevant examples.

In 2018, Germany's military procurement agency (BAAINBw) excluded two historical national shipyards, ThyssenKrupp Marine System (TKMS) and its partner Lürssen, from bidding for the MKS 180. According to the BAAINBw, the price proposed for the four warships was too high (\leq 4Bn), and TKMS could no longer be considered a reliable partner. In effect, the company was fined several times for cost overruns and delivery delays in the previous years. The tender was awarded to a foreign company, the Dutch Damen Shipyards. The other finalist, the Franco-Lebanese owned, and German based German Naval Yards, appealed the decision. It finally withdrew when Lürssen Group was offered participation as sub-contractor, thus preserving the presence of national companies. This example shows that hosting different important military shipyards does not necessarily mean producing cost-efficient or highquality vessels, a situation that might finally convince governments to buy abroad.

France and Italy

In February 2018, the French Agence des Participations de l'Etat (APE) and Fincantieri Europe (a branch of Fincantieri) signed the share purchase agreement for STX France, which was supposed to mark the last step of a year-long acquisition dispute around Chantiers de l'Atlantique (Saint Nazaire). In 2016, when STX France (part of STX Europe, a European subsidiary of the South Korean STX Offshore&Shipbuilding) was offered for sale following STX's bankruptcy, Fincantieri was the only bidder. According to the preliminary agreement, the Italian group was expected to purchase a 66.6 per cent share of STX France at €79.5M. However, France (a 33.3 per cent shareholder of STX France with pre-emption rights on the remaining shares) opposed the agreement for several reasons, including preserving jobs, maintaining local production, and avoiding technology draining abroad. Worried about Fincantieri's operations outside Italy, France finally offered the company a minority share of STX France (51 per cent). When the Italian shipyards refused, Paris decided to purchase the remaining STX France shares, thus becoming the 100 per cent shareholder. Today, Chantiers de l'Atlantique is owned by the French state (with 84.3 per cent of the capital), Naval



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Rendering of a Naval Group's FDI

Group (11.7 per cent), employees (2.4 per cent) and local companies (1.6 per cent). After several years of negotiations, the Italian and French Governments officially announced the termination of Fincantieri's acquisition programme in January 2021.

In parallel with negotiations concerning Chantiers de l'Atlantique, Naval Group and Fincantieri decided to strengthen their cooperation in the civil and military sector. Their 50/50 joint venture, Naviris, which became operational in January 2020, "embodies the strength of the partnership and the convergence of long-term vision between the two parent companies", the official website states. To somehow "seal" this collaboration, the two companies launched the European Patrol Corvette (EPC) programme, to be developed in collaboration with the Spanish-based Navantia and to potentially bid for European Defence Funds, which could cover up to 10 per cent of the total programme costs. The agreement undoubtedly heads in the right direction but demonstrates the abovementioned limits to integration when commonalities are in guestion: a kind of interference by less competitive countries looking to hinder the merger, refusal to close unproductive shipyards, hoping that others will do so, and arguing about the division of responsibilities and workloads. Indeed, the fact is that the two companies continue to participate separately for international bids.

Procurement for New Greek Frigates

Naval Group and Fincantieri are not only competitors in this tender, but they have proposed two different narratives, demonstrating that their alliance remains incomplete. For its four new frigates (and two gap-filler vessels), Athens is seeking good quality vessels and the opportunity to relaunch its national military shipbuilding industry, which has been stagnant for several years now.

The Italian shipyard competes with FREMMs based on the Italian Navy's ASW version, with first deliveries expected in 2025, and two upgraded MAESTRALEclass units as gap-fillers, with a handover due within 9 to 12 months from signature. Thanks to a "strategic partnership" which also includes collaboration in the civil sector, Fincantieri proposed the modernisation of Hellenic Shipyards SA, based in Skaramangas (near Athens), and its integration into the "Fincantieri constellation". After an adequate training in Italy during the construction of the first vessel, Greek workers would be able to build the three remaining ships in Greece. Naval Group proposes its Frégate de Défense et d'Intervention (FDI), an ambitious and advanced project (albeit concrete, since the first French unit is already under construction) that the company describes as more innovative than its rivals. Concerning gap-fillers, the company proposes the purchase or leasing of two GOWIND 2500 'light corvettes/frigates' in a configuration similar to the Egyptian one or, in agreement with the French Government, the ageing LATOUCHE-TRÉVILLE frigate (LE-YGUES class) and the JEAN BART destroyer (CASSARD class) just decommissioned by the Marine Nationale. The latter offer has apparently been rejected or disparaged on the grounds that the two ships are in very bad condition. Naval Group though considers that they are usable and would be sold almost free of charge. After a long assessment of the Greek industry and following its experiences in Egypt, Brazil, India and others, Naval Group proposed investments in SMEs to rebuild and relaunch the Greek value chain in the shipbuilding sector. The French plan would be based on extensive technology transfer to a selection of the best and most competitive Greek companies rather than in investments to modernise big shipyards.

The competition between these two European companies could finally favour Lockheed Martin, which is proposing its LCSbased frigate and two ex-U.S. Navy LCSs as gap-fillers. Indeed, Washington is promoting US frigates as a central element in bilateral relations, and a good first step to regain the lost influence in the Mediterranean.

Final Remarks

Integration among European shipyards might open new market opportunities and provide the degree of competitiveness needed to maintain a leading position on the international market. If some examples of integration have emerged in recent years, their impact on the market position of the concerned shipyards remains limited, as each company continues to pursue its own objectives. For example, Fincantieri has announced that it might consider participating in an eventual tender for TKMS's submarine division to "consolidate the company's position on the European market". According to Fincantieri's CEO Giuseppe Bono, such an agreement "is not in contrast with the agreements with Naval Group, which is always kept informed". But as has already happened with the Kockums-TKMS merger in the '70s, this manoeuvre might finally be driven by the willingness to eliminate a potential competitor rather than fully benefitting from aggregation. Reality shows that shipyards continue to prefer case-by-case collaborations to win tenders. Indeed, cooperating for specific operations requirements and scenarios allows for increasing winning opportunities without having to suffer others' inefficiencies in other subsectors. However, this form of collaboration is not sustainable in the long term, as it heavily depends on contingencies such as defence budgets and programmes.

Industry-driven considerations are not strong enough to boost aggregation. European defence funds have not proven to be an effective push factor so far, but are rather being considered as a way to fund R&D without increasing national defence budgets. Conversely, an aggregated strategic planning establishing new dynamics in the collaboration between armed forces and shipyards when it comes to tenders might prove to be a more effective push factor.



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POWER AT SEA

Transatlantic Industrial Cooperation: West to East

Andreea Stoian Karadeli

Transatlantic cooperation emerged following two World Wars and has been defining its shape ever since. While this bond has never been guaranteed, the transatlantic partnership has always required that the main actors adapt their positions to developing geopolitical contexts. Today's transatlantic community is bigger and more diverse, marked by intertwined economies, global markets and a higher level of interdependence between countries.

While differences between military and civilian technology have become harder to define and the fourth industrial revolution awaits just around the corner, transatlantic industrial cooperation should be modernised, and become stronger and more flexible than it has ever been.

Current Trends

One of the most visible features in transatlantic relations has remained the asymmetry between the so-called "dominant US" and a "weak Europe". While the EU has struggled to portray itself as more autonomous, there is still a long way to go for a lasting balance to be achieved in order to counter the longstanding political, strategic and technological weakness perceived by the international community. Bearing in mind the current context and the international focus on defence and security, the only feasible way to achieve a transatlantic balance is for the EU to consolidate its defence and industry related policies. In this regard, defence integration initiatives and funding should remain inclusive for weaker Eastern European countries and their strategic and industrial preferences.

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The Boeing MH-139A GREY WOLF is a primary example of transatlantic industrial cooperation.

At present, the transatlantic defence industry has reached a higher, although not yet sufficient, level of integration that produces the necessary capabilities to protect and defend both the EU and US societies. Still, the most advanced safeguarding capabilities can only be obtained through close collaboration between the industrial actors on both sides of the Atlantic. While capability requirements are well defined at the strategic level, industry is needed to build and deliver those capabilities. Therefore, NATO Allies and European partners should strengthen their industrial and technological cooperation, not only in response to certain threats or events, but also as part of a preventive strategy. In this regard, increased defence budgets must be urgently matched by more efficient pooling and sharing of Europe's resources, research investments and equipment production cycles if Europe is to narrow the burden-sharing gap with the United States and take care of its own strategic priorities and operations where the US is unlikely to be involved. As this debate has unfolded over the last five years, two distinct challenges have arisen. The first is to define what an autonomous defence industrial and technology base means for the EU and how this could also benefit NATO and the wider cause of transatlantic burden-sharing. This has to be grounded in a conviction that a stronger EU defence capability is good for the US, and not just for Europe, and as such, something that Washington should encourage rather than view as a rival. Given that 22 EU Member States are also NATO allies, it makes sense for the two organisations to work more closely together to ensure that EU initiatives such as the Permanent Structured Cooperation (PESCO) and the European Defence Fund (EDF) both harmonise and support the urgent capability requirements of both organisations.

International Armoured Vehicles

Based on the analysis and predictions of several international reports, the global armoured vehicle market size is projected to grow from US\$11.6Bn in 2020 to US\$15.4Bn by 2025, at a CAGR of 5.8 per cent from 2020 to 2025. The rise in the instances of cross-border conflicts and in incidences of asymmetric warfare across the globe are just two of the major driving factors behind the increasing demand for armoured vehicles and the growth of the armoured vehicle market. The rise in the instances of asymmetric warfare has led government agencies to adopt combat vehicles for self-protection and defence against terrorist or insurgent attacks as armoured vehicles offer protection against ballistic as well as blast attacks. Moreover, these vehicles have turret gun systems to carry out counter-insurgency operations.

Currently, the armoured vehicle market is mainly concentrated in the North American and European regions, owing to the presence of large OEMs such as BAE Systems, General Dynamics, Rheinmetall, and Nexter Systems in these regions. Emerging armoured vehicle markets can also be found in the Middle East and Asia Pacific, but the countries in these regions are still dependent on foreign OEMs for armoured vehicles. This results in expensive procurement procedures, resulting in a decrease in their overall demand. Still, the demand for unmanned systems has increased



Swedish technology group Saab has begun production of the fuselage for the US Air Force's new T-7A trainer. Saab had developed the jet trainer together with Boeing. The T-7A is to replace the T-38 TALON in the US Air Force.

across the globe in recent years due to their increased use by military forces of different countries for carrying out Intelligence, Surveillance, and Reconnaissance (ISR) and combat operations. Moreover, the declining defence budgets of advanced economies such as the UK, Italy, Spain, Germany, and France has led to the increased procurement of unmanned systems to replace their defence personnel, which make use of large volumes of equipment and logistic support. Based on the platform required, the armoured vehicle market has been divided into combat vehicles, combat support vehicles, and unmanned armoured ground vehicles. The combat vehicle segment is projected to lead the armoured vehicle market during the forecasted period. Increased demand for Armoured Personnel Carriers (APCs) and Light Armoured Vehicles (LAVs) across the globe is leading to the growth of the combat vehicle segment of the market. Based on the



system, the armoured vehicle market can be broken down into engines, drive systems, ballistic armour, turret drives, fire control systems, armaments, countermeasure systems, Command & Control (C2) systems, power systems, navigation systems, ammunition handling systems, observation & display systems, and hulls/frames. The armaments segment is estimated to lead the armoured vehicle market from 2018 to 2023. The growth of this segment can be attributed to the increased demand for remote weapon stations, anti-tank guided missile (ATGM) launchers, and other armaments across the globe.

COVID-19 Impact

As the virus still represents a global threat, the effects of the pandemic on transatlantic industrial cooperation are still hard to define. While coronavirus may complicate efforts to restart an ambitious transatlantic free trade deal because of populist forces that do not want to expose national economies to more competition in sensitive sectors, it may lead to renewed focus on more modest, pragmatic and immediately achievable goals - including the elimination

of tariffs on the industrial goods trade. Also, bearing in mind that COVID-19 places new external and internal pressures on Western democracies, it accelerates the global trend of a relative weakening of the West. As a result, Europe and the US need to stand together to defend our democratic systems and our security in the face of growing authoritarian influence. Transatlantic cooperation on various levels, and especially in terms of industry and defence, is needed to tackle the risks of foreign-made 5G networks, new surveillance technologies, economic dependencies and disinformation, while not forgetting about the continued need for investments in military defence and deterrence capabilities.

So far, the COVID-19 pandemic has caused a multi-level impact on economies globally. The global manufacturing of automotive parts, components, and assembly lines has been severely impacted. Although the production of armoured vehicles is of prime importance for national and international security, disruptions in the supply chain have set back their manufacturing for the time being. As a result, the entire supply chain is disrupted due to the limited supply of parts. Chinese suppliers around the globe have placed production lines on hold or shut them down completely. Nevertheless, legal and trade restrictions, such as sealed borders and new customs regulations, increase the shortage of required parts. Such disruptions in the supply chain are expected to affect the assembly of OEMs in Europe and North America. Resuming the manufacturing and delivery of armoured vehicles depends on the level of COVID-19 exposure a country is facing, the level at which manufacturing operations are running, and import-export regulations, among others. Although companies may still be taking orders, delivery schedules might not be fixed.

Conclusion

The current geopolitical context requires that transatlantic cooperation reaches its highest level in all areas in order to ensure both societal protection and development. While industry and defence must remain at its core, no other field should be left behind. Now, more than ever, a preventive strategy instead of a reactive one is necessary and can only be achieved through international cooperation.



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Serbian Defence Industry Aims for Exports

Christopher F. Foss

The Serbian defence industry has now firmly re-established itself as one of the key players in Europe with the capability to design, develop and manufacture a wide range of weapon systems, especially in the key land sector.

arketing of these is carried out by Yugoimport SDPR with the backing of the Serbian MoD as well as a number of government agencies and establishments such as the Material Resources Sector and the Defence Technologies Department. The Military Technical Institute (MIT) is by far the largest scientific research element in Serbia and its main areas are classical armament, vehicles, artillery systems and ammunition, aircraft and electronic systems and materials. According to the MIT, over the last seven decades, it has developed over 1,300 key items of equipment and today has supplied about 75% of the weapons and equipment used by the Serbian armed forces, in addition it has won major export contracts in recent years, especially for artillery systems.

The NORA B-52

One of the best-selling equipment is their NORA B-52 (8x8) 155 mm/52 CAL self-propelled (SP) artillery system which was one of the four systems recently tested in the US to meet a US Army requirement for a 155 mm Wheeled Gun System (WGS). This has been constantly enhanced with the latest version having a protected cab with the 155 mm/52 calibre ordnance with a 23 litre chamber that meets the NATO Joint Ballistic Memorandum of Understanding (JBMoU) in a protected turret at the rear. Maximum range depends on the projectile and charge combination but firing a locally produced 155 mm high-explosive extend-

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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 also driven over 50 tracked and wheeled AFVs.



Serbian NORA B-52 155 mm/52 calibre SP artillery system based on an 8x8 platform and shown here in the travelling configuration



Serbian LAZAR (8x8) APC can be fitted with a wide range of turrets including this Russian turret armed with a 30 mm cannon and 7.62 mm co-axial MG.



The latest wheeled AFV to be developed in Serbia is the MILOSH 4x4 shown here fitted with a locally developed remote weapon station armed with a machine gun.

ed-range full-bore base bleed (HE ER FB BB) projectile a maximum range of up to 44 km is claimed with a total of 36 projectiles and associated charges carried. In addition to being deployed by Serbia, export sales have been made to Bangladesh, Kenya and Myanmar and most recently Cyprus.

The ALEKSANDAR MGS-25

Serbia has also developed a new version on an 8x8 chassis called the ALEK-SANDAR MGS-25 155 mm/52 cal SP artillery system which is being marketed with a 23 or 25 litre chamber. This has a remote controlled turret at the rear which is provided with 12 rounds of ready use ammunition (projectile, charges and fuses) with additional 12 x 155 mm rounds of ammunition in a pod to the immediate rear of the protected cab.

This 8x8 chassis is used for a number of other more recent applications including a modular rocket launcher. Mounted at the very rear of one version of the chassis are two pods each of 24 x 122 mm unguided rockets with an additional two pods to the immediate rear of the cab for rapid reloading. An alternative is two pods each of six 267 mm unguided rockets. This chassis is also used to transport and launch the longer-range SHUMADIJA rocket.

New Ammunition

As well as developing 155 mm tube artillery and a range of artillery rocket systems (ARS), Serbia has made major investments in developing new ammunition for their systems with increased range and more target effect. A good example are their 122 mm rockets which as well as being fired from Serbian ARS can also be fired from foreign rocket launch-





Serbia offers a number of artillery upgrade packages including a 6x6 platform with a protected cab with a turret mounted 105 mm howitzer at the rear.



The latest 8x8 chassis used for the NORA B-52 155 mm/52 calibre SP artillery system is now being used for other applications such as the ARS with two pods of 122 mm rockets at the very rear and additional rockets to rear of cab for rapid reloading.



The locally developed MILOSH unmanned ground vehicle is armed with a 7.62mm machine gun with sensor pod above.

ers such as the widely deployed Russian 122 mm BM-21 ARS.

Baseline 122 mm rocket only has a range of 20.3 km but new 122 mm rockets with range of 28, 40 and 50 km have been developed.

The LAZAR

In the past, the former Yugoslavia undertook production of their own version of the Russian T-72M1 main battle tank (MBT) under the local designation of the M-84 and this had ha host of modifications to meet local requirements. Serbia has developed upgrades to the M-84 MBT to extend its operational life and enhance its capabilities, especially in the areas of fire control and survivability.

Now in production in Serbia for the home and export markets is the LAZAR (8x8) which in addition to being used as an armoured personnel carrier (APC) fitted with a locally developed remote weapon station (RWS) armed with a 12.7mm machine gun (MG), can also be fitted with a two person turret armed with a 30mm dual feed cannon and 7.62mm co-axial MG.

When compared to other 8x8 platforms LAZAR has a high interior volume of 15 m3 with gross vehicle weight (GVW) being up to 28 tonnes which depends on armour package and weapon installation. To meet different user requirements it is being marketing with different layers of protection.

The **MILOSH**

The latest AFV to enter production in Serbia is the MILOSH (or BOV M16) which is being marketing for a wide range of battlefield missions. When being used as an APC, it would typically have a crew of three consisting of commander, gunner and driver with space for five dismounts. Typical weapon fit would be a locally developed RWS armed with a 12.7mm MG. In addition to being deployed by Serbia, a batch of MILOSH has been exported to Cyprus as command/fire control vehicles deployed by the NORA B-52 155 mm/52 calibre SP artillery system.

For many years, Serbia has manufactured the Russian MALYUTKA (or SAGGER as it is usually referred to in the west) antitank guided weapon (ATGW). The Serbian MIT has carried out a number of MALYUTKA upgrades including a new guidance system in which all the operator has to do is keep his sight locked into the target until missile impact. The latest versions are the MALYUTKA 2F with a thermobaric warhead and the 2T with a tandem high-explosive anti-tank (HEAT) warhead to neutralise targets fitted with explosive reactive amour (ERA). Both of these have a maximum range of 3,000 m but the latest MALYUTKA 2T5 is fitted with not only a new HEAT warhead with increased penetration characteristics but also a longer solid propellant rocket mortar to increase range out to 5,000 m. In addition to being deployed in the standard infantry version, these upgraded MALYUTKA are also launched by the BOV (4x4) APC which is still used for a wide range of battlefield missions including command and control and artillery observation.

UAVs and UGVs

Unmanned aerial vehicles (UAV) and unmanned ground vehicles (UGV) have not been neglected by Serbia as these are becoming increasingly important. The MIT have developed and tested the MI-LOS UGV and is normally transported to near where it is to be deployed by a trailer towed by a 4x4 vehicle which also hosts the operator's controls and the mast mounted sensor pack which enables the



Serbia has manufactured the Russian MALYUTKA ATGW for many years but has developed enhanced versions with a longer range and enhance warhead.

operator to track the MILOS UGV out to a range of at least 3,000 m.

The sensor pack on the MILIS UGV includes a charge coupled day (CCD) camera and thermal cameral for observation plus additional cameras for driving. A 7.62 mm MG with 500 rounds of ready use ammunition is fitted plus a six round 40 mm revolver type grenade launcher. As Serbia is not a member of NATO, and unaligned with any of the major powers it has access to wide markets in Africa, Asia and the Middle East as well as the home market.







The Czech Defence Industry Today

Martin Smisek

This article is a summary of some of the current capabilities and developments within the Czech defence industry on the occasion of the IDET 2021 exhibition in Brno.

Czech companies engaged in research, development, production, trade and marketing of the military and security equipment, along with related services are associated within the Defence and Security Industry Association of the Czech Republic (DSIA); this was established in 1997 as a non-governmental, independent, apolitical, non-profit organisation. DSIA supports the pro-export efforts of radiological and nuclear (CBRN) protection systems, combat clothing and personal equipment, military electronics and communication systems but also in cybersecurity, artificial intelligence, computer information systems, research and development. Almost 90 per cent of the production is sold abroad. In 2019, defence industry companies from the Czech Republic exported goods and services in



The first prototype of the AERO L-39NG (serial number 0475, construction number 167001) flew for the first time on 22 December 2018.

its member companies and helps them to look for new markets. It also participates in the shaping of the Czech pro-export policy and supports the export interests of its members towards the Czech state administration.

Today, DSIA brings together nearly 130 Czech companies involved not only in the production of military vehicles and aircraft, small arms, chemical, biological,

<u>Author</u>

Martin Smisek is a Czech freelance journalist specialising in Czech armament programmes and Czech and Slovak military history since WW II. the value of \in 619.29M which accounted for roughly 1 per cent of military-related exports from the European Union.

The dominant player is Czechoslovak Group (CSG), a holding company with some 8,100 employees whose sales reached more than €566M in 2020. Except for enterprises with civilian-oriented portfolios, CSG includes today some of the vital Czech defence companies such as Excalibur Army, Tatra Trucks, Tatra Defence Vehicle and Retia. Its foreign branch is organised within MSM Group with businesses including MSM Martin, MSM Banská Bystrica, MSM Nováky, MSM Land Systems, ZVS and VÝVOJ Martin based in Slovakia, as well as 14. Oktobar in Serbia and FMGranada in Spain. In addition, CSG is currently in the process of establishing a joint venture company with Rheinmetall. The enterprise will develop and produce tactical military vehicles and will be placed in Kopřivnice. While CSG will put its production capacity into the project, the Germans will bring actual contracts.

State-Owned Companies

An important part of the Czech defence industrial base is constituted of four enterprises owned by the Ministry of Defence of the Czech Republic. The biggest of which are LOM Praha in Prague and VOP CZ in Šenov near Nový Jičín, each with approximately 850 employees.

The former provides repairs, general overhauls, lifecycle support and upgrades of Mi-8/17/171/24/35 helicopters and L-39C ALBATROS jet trainers. The recent projects include general overhauls of Mi-17 and Mi-24/35 helicopters for the Czech Air Force (CzAF) as well as Mi-17V-5 helicopters for Ghana and Afghanistan and modernisation of Mi-17s for Burkina Faso. The essential role plays the upgrade of seven Mi-171Š helicopters of the CzAF into the advanced Mi-17ŠM version which is a product of in-house development.

Within the broader frame of the UH-1Y and AH-1Z acquisition programme for the CzAF, LOM Praha is preparing a concept of the centre of excellence that will provide the company with the ability to carry out comprehensive lifecycle support of H-1 helicopters, including training of aircrews and ground support personnel. The aim is to establish a closer relationship with Bell Textron Inc. that will go beyond the scope of the helicopters operated by the CzAF.

LOM Praha also operates Flight Training Centre (Centrum leteckého výcviku, CLV) at Pardubice airport that provides comprehensive and modular training programmes for both fixed-wing and rotary-wing aircraft pilots, flight engineers, ground crews and maintenance personnel. The aircraft fleet is primarily



ERA's VERA-NG passive ESM (Electronic Support Measure) tracker in a version using the Ftm 25/6 container-based antenna mast system from SMAG.

composed of Enstrom 480B-G and Mi-17 helicopters, Z-142CAF basic trainers, L-39C jet trainers, and L-410 light transport airplanes.

The core business of VOP CZ constitutes the development and production of tracked and wheeled military vehicles, along with repairs, refurbishments and upgrades of tanks, armoured personnel carriers, infantry fighting vehicles (IFV) and engineer equipment. Since 2012, the company has been developing the TAROS unmanned ground vehicle, the reconnaissance variant of which – UGV-Pz – was introduced into the Czech Army inventory in 2020. Between 2015 and 2017 VOP CZ manufactured 450 armoured cabs for AJBAN 440A light armoured vehicles of NIMR Automotive. From 2016 to 2020, the company, in cooperation with Kobit delivered 15 CAP-6M1 fuel trucks for the Czech Army. An additional seven CAPL-16M1 and two CNS aircraft refuellers for the CzAF will be delivered until November of this year.

In 2021, the company signed a contract for the supply of armoured vehicles for Achleitner from Austria. The deal includes both the supply of armoured cabins and the final assembly of entire vehicles. VOP CZ currently works on the update of all T-72M4 CZ tanks of the Czech Army. In addition, the company plays a crucial role in the Czech IFV programme in which it serves as the project integrator for the Czech industry, main subcontractor and future service authority for the vehicles of the Czech Army.

Vojenský technický ústav (VTÚ) with its headquarters in Prague is composed of three divisions based at Vyškov (Vojenský technický ústav pozemního vojska), Slavičín (Vojenský technický ústav výzbroje a munice) and Prague (Vojenský technický ústav letectva a protivzdušné obrany) VTÚ concentrates its activities on research and development of new weapon systems, C4ISTAR (Command, Control, Communication, Computer, Intelligence, Surveillance, Target Acquisition, Reconnaissance) systems, ammunition, armaments and equipment of the air and ground forces. Among the recent projects are, for example, SOM-6NG security guard and surveillance system for the Military Police, production of 10,000 60 mm HEI-LD mortar rounds for the Czech Army and the upgrade of the Czech Army communication architecture within the frame of NATO's Federated Mission Networking.

The last state-owned enterprise is Vojenský výzkumný ústav (VVÚ) from Brno that focuses on research and development in three basic areas: CBRN protec-



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The T-72 SCARAB low-cost modernisation proposed by Excalibur Army uses a more powerful V-84 engine, DYNA reactive armour, slat armour and upgraded sight equipment.



The Mi-171Š SOF II is the most advanced upgrade of the Russian Mi-171Sh series of helicopters designed at LOM Praha. These helicopters are operated by the Special Operation Air Task Unit of the 222nd Helicopter Squadron of the Czech Air Force.

tion, special electronics and camouflage (electronic intelligence, electronic warfare, multispectral camouflage systems) as well as materials engineering (metal and composite ceramic armour, passive and reactive armour). VVÚ currently carries out the development and delivery of the STARKOM mobile armoured jammer along with S-LOV-CBRN and S-LOV-CBRN II armoured vehicles for CBRN reconnaissance. The company simultaneously provides qualification testing of armoured vehicles against mine and IED threats according to STANAG 4569 and carries out theoretical and practical training of local and foreign personnel in CBRN protection. VVÚ also performs

research and development of hard-kill active protection systems (project PAO for the Czech Army).

Small Arms

Unsurprisingly, the dominant player in this field is Česká zbrojovka (CZ) which is a member of Česká zbrojovka Group SE (CZG), one of the leading global manufacturers of firearms and tactical accessories for military and law enforcement, personal defence, hunting, sport shooting and other civilian uses. The current range of CZ's military products comprises 9x19 mm NATO pistols (P-07, P-09, P-10 C, P-10 F), 9x19 mm NATO and 9x21 mm submachine guns (CZ SCORPION EVO 3 A1), 5.56x45mm and 7.62x39 assault rifles (BREN 2, CZ 807), 7.62x51 mm battle rifles (BREN 2 BR), 308 Win. sniper rifles (CZ TSR) and 40 mm grenade launchers (CZ 805 G1).

One of the most important recent deals for CZ was awarded by the Ministry of Defence of the Czech Republic in April 2020. The financial volume of the framework contract is up to CZK2.35Bn excluding VAT and by 2025 would see the Czech Army obtain more than 16,000 BREN 2 assault rifles (including 350 BREN 2 BRs), more than 21,000 P-10 pistols, more than 1,600 CZ 805 G1 grenade launchers and nearly 100 CZ SCORPION EVO 3 A1s, including related accessories and spare parts.

May 2021 was pivotal for the further development of the CZG since it successfully completed the acquisition of the American arms manufacturer Colt Holding Company LLC, including its subsidiaries Colt's Manufacturing Company LLC and Colt Canada Corporation.

Military Vehicles

The leading role in this segment is held by several companies from CSG holding. The portfolio of Excalibur Army (EA) is composed of wheeled armoured vehicles (PATRIOT I, PATRIOT II), 155 mm wheeled gun-howitzers (DITA and a new howitzer with L/52 barrel currently under development), 122 mm rocket launchers (RM-70 VAMPIRE), support vehicles (AM-50 EX and AM-70 EX bridge layers, DECON decontamination vehicle, TREVA-15 and TREVA-30 recovery vehicles, KAPA amphibious vehicle), as well as repairs and upgrades of Warsaw Pact era tanks, IFVs, howitzers and rocket launchers.

While three PATRIOT I vehicles were manufactured for Indonesian engineer troops, two PATRIOT IIs under the name TRITON were bought by the Fire Rescue Corps of the Czech Republic. The Indonesian Armed Forces also obtained more than 16 AM-50 EXs, two TREVA-15s and eight RM-70 VAMPIREs. On 22 February 2021, an agreement was signed between EA and PT Republik Defensindo for the joint production of the VAMPIRE rocket launchers on the T815-7 chassis in Indonesia. All vz. 77 howitzers of the Polish Army will be upgraded to the DANA M2 standard (under the name DANA-M) by local industry. Another 26 examples of the DANA M2 howitzer will be delivered to Ukraine.

One of the youngest Czech defence industry companies is Tatra Defence Vehicle (TDV) based in Kopřivnice and operating since 2015. In 2020, TDV completed the delivery of 20 PANDURs IIs in KOVS and KOVVŠ versions for the Czech Army. The company is today the single manufacturer of Pandur II vehicles in 8x8 configuration. Thus, TDV currently produces 24 PANDURs for Indonesia together with an additional ten vehicles in the fire support variant with 105 mm gun for the Philippines. At the same time, TDV will produce 62 TITUS vehicles in KOVS, KOVVŠ and MKPP versions for the Czech Army. The armoured cabs for the T815-7 line of vehicles are also manufactured by TDV.

One of the oldest car manufacturers in the world, Tatra Trucks, needs no introduction. The company currently works on the production of 879 DAF CF military trucks (in fact versions of the T158 PHOE-NIX) for the Belgian Armed Forces. Tatra will deliver 636 trucks in a 4x4 chassis configuration and 243 vehicles in the 8x8 version. Of the total number of trucks. 352 vehicles will be fitted with armoured cabs developed and manufactured by TDV. In recent years, Tatra delivered almost 200 T815-2 trucks for the Indian Army in the form of complete knockdown (CKD) kits. Additional CKD sets for more than 400 trucks for the Indian mili-



Among Retia's latest products is ReGUARD, a multipurpose 3D radar for detecting and tracking ground objects and slow, lowflying aircraft.



The UAV ONE 150 unmanned aerial reconnaissance vehicle is the product of young Czech company Primoco. In its latest variant, the aircraft can be equipped with the SAR radar of the US company, Imsar.



The VEGA multi-purpose armoured vehicle of the SVOS company is based on the Tatra 815-7 chassis in both 4x4 and 6x6 configurations.

tary will be delivered in 2021 and 2022. Twenty-nine T815-7 chassis served as the basis for the M4K armoured recovery vehicles for the Turkish Army.

During this year, Tatra is completing the production of 37 T815-7 6x6 and 34 T810 6x6 cargo bed trucks along with 31 T815-7 8x8 container carriers for the Czech Army. The deliveries of T815-7 trucks for the NEPTUN anti-ship missile system and other Ukrainian radar and rocket systems are currently underway. Moreover, the T815-7 chassis serves as a basis for different armoured vehicles and self-propelled howitzers. A contract for the supply of 328 T815-7 4x4 chassis (primarily for AL-WAHSH armoured vehicles) was signed with the Jordanian customer in 2019.

Outside of the CSG holding,SVOS produces armoured conversions of commercial vehicles (such as Toyota LC200s for the United Nations) and is offering VEGA and PERUN multi-purpose armoured vehicles.

Ammunition

The traditional Czech producer of military, sport and hunting small arms ammunition is Sellier & Bellot that was founded already in 1825. Its law enforcement and military ammunition has been successfully delivered to more than 40 countries globally, especially to NATO members. The major success in recent years was winning the Scandinavian tender which includes the supply of training and special pistol ammunition to the police forces.

STV Group is the sole Czech producer of large-calibre artillery and tank ammunition. Its manufacturing plant at Polička also produces 9x19 mm Luger, 12.7x99



TACTIC is the latest variant of the T810 series of medium trucks. The vehicle uses a cab unified with the T815-7, Cummins ISB engine and Allison 3200SP automatic transmission.



The new version of the PANDUR II 8x8 infantry fighting vehicle proposed by TDV is armed with a TURRA 30 unmanned turret equipped with the CRANE gunner's sight and CMS-1 panoramic sight manufactured by EVPÚ Defence.



The UGV-Pz reconnaissance unmanned ground vehicle was developed by VTÚ using the TAROS platform of VOP CZ. The system was introduced into the inventory of the 102nd Reconnaissance Battalion of the Czech Army.

mm (.50BMG) and 12.7x108 mm ammunition, mortar rounds, as well as ammunition for RPG-7 rocket-propelled grenade launchers such as the TB-7V thermobaric round. Although the Czech Army is a regular customer, most of the production is exported. Besides, the STV's facility at Polička is also used for the repairs of armoured vehicles and other heavy weapons such as vz. 70/85 rocket launchers and vz. 77 howitzers of the Polish Army or BVP-2 IFVs and vz.77s of the Czech Army. In 2019 and 2020, STV overhauled BMP-2 IFVs and T-55A tanks of the Uganda People's Defence Force with the latter being equipped with explosive reactive armour blocks.

The company Zeveta Ammunition a.s is also active in the field of research, development, production, testing, defusing and destruction of ammunition. Among the products are 26.5 mm signal equipment, decoys for aircraft protection, the RPG-75 light anti-tank weapon, smoke grenades for armoured vehicles, hand grenades, flash and sound grenades, as well as detonators and imitation pyrotechnics.

Aerospace

The third oldest aircraft manufacturer in the world, Aero Vodochody Aerospace, has high hopes for its new L-39NG jet trainer. In 2018, Aero signed a contract for the delivery of four L-39NGs in light combat configuration to the Senegalese Air Force. In February 2021, the Vietnamese Ministry of Defence ordered 12 L-39NG airplanes including the training of pilots and ground crews, the supply of spare parts as well as equipment for ground and logistics support. LOM Praha plans to buy four L-39NG trainers for its CLV. At the same time, Aero wants to succeed with its new jet trainer in Slovakia. The company also performs overhauls and upgrades of legacy ALBATROS airplanes. In recent years, this process has involved, for example, L-39 aircraft of the Nigerian (three airplanes), Ethiopian, Kazakh and Uzbek Air Forces (six airplanes each). Moreover, Aero produces subassemblies (all doors, loading ramp, rear fuselage section) for Embraer C-390 MIL-LENIUM transport aircraft.

Aircraft Industries, the manufacturer of the TURBOLET light transport aircraft, delivered two L-410UVP-E20 in the maritime surveillance variant for the Polish Border Guard in October 2020. The company currently provides R2/R3 overhauls for the fleet of seven L-410s operated by the CzAF.

The young Czech company Primoco is the creator of the UAV One 150 unmanned aerial reconnaissance vehicle with a wingspan of 5 m and a maximum take-off weight of 150 kg. The airplane is certified according to STANAG 4703 and is completely developed and manufactured in the Czech Republic except for three components from Spain and Norway. The most active user of the UAV One 150 today is the Royal Malaysian Air Force which uses it for patrol missions in several areas along its sea and land borders. In 2021, Primoco plans to sign contracts for the delivery of 67 aircraft for 16 customers in Asia, the Middle East, Africa and Europe.

The company První brněnská strojírna (PBS) from Brno is also active in the field of UAVs with its line of turbojet engines. Particularly important is the TJ100 which has achieved worldwide success, having been sold in over 40 countries. Developed for UAVs, target drones, light sport aircraft and motor gliders, the TJ100 is a single-shaft powerplant with a single-stage radial compressor, annular combustion chamber, single-stage axial turbine, and stationary exhaust nozzle with a thrust of up to 1,250 N.

Radar and Passive Surveillance Systems

Several new radar technology companies were founded on the ruins of communistera Tesla Pardubice. Among them are Retia, Eldis ERA and T-CZ, the former two are currently part of the CSG holding.

Retia develops, produces and upgrades radar systems along with C4I2 air defence systems. The company also provides electronics integration for PAN-DUR II and TITUS vehicles recently delivered or ordered for the Czech Army. In 2019, Retia delivered two upgraded 1S91 "STRAIGHT FLUSH" fire control and guidance radars for the US military which uses them as thread simulators. The company is currently upgrading the RACCOS air defence automated command and control fire distribution system of the CzAF. At IDEX 2021, the company signed a Memorandum of Understanding with Jordan Design and Development Bureau which plans to integrate Retia's ReGUARD which is a multi-purpose 3D radar for detecting and tracking ground objects and slow, low-flying targets with a small radar cross-section. In addition, Retia is directly participating in the acquisition of eight EL/M-2084 radars for the CzAF. The company provides support for the installation and integration of radars into certified information systems together with the production of DTRM and DRM modules.



The STARKOM mobile armoured jammer, the product of Vojenský výzkumný ústav, is based on the T815-7 chassis with all-steerable axles. Its electronic surveillance and warfare sub-system is provided by URC Systems.

Presently, ERA, well-known for its passive surveillance systems, works on the Czech Army's order of two VERA-NG systems in the latest configuration that, among others, enables tracking of micro and mini UAVs at the range of more than 100 km. Among the latest customers of the VERA-NG are Indonesia, as well as Vietnam which use the container-based mast system of German company SMAG.

Optronics, Communication Systems and Electronic Warfare

EVPÚ Defence focuses its business activities on the development, design, production and service of electro-optical systems, pan tilt positioners, day-night and thermal imaging cameras, sights, as well as laser and radar irradiation detection systems. At the top of the portfolio are multi-sensor weapon station gunner sights of the CRANE series, CMS-1 panoramic commander sight and LAWAREC BRICK laser warning receiver for military vehicles. In April 2021, EVPÚ Defence signed a contract for the delivery of 11 GLADIUS remote weapon stations, which are assembled by the parent company EVPÚ in Slovakia, for LMV vehicles of the Czech Army. Handheld, manpack, vehicular and base radios, as well as digital intercoms for light and heavy armoured vehicles are represented by products manufactured by MESIT from Uherské Hradiště. Vehicles introduced recently into the Czech Army inventory are usually equipped with VICM 200 intercoms.

In the area of electronic warfare, signals intelligence and C4ISTAR, the products and software solutions of URC Systems are crucially important for the Czech Army. Typical products include the STAR LIGHT 3 and STAR MANPACK series of protection jammers used by the Czech military.



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Optionally Manned Fighting Vehicle A Status Report

Sidney E. Dean

After the US Army's Ground Combat Vehicle programme was discontinued in 2017, the Next-Generation Combat Vehicle (NGCV) programme was established. It intends to replace the M2 BRADLEY which is nearing the end of its service life.

he US Army's Optionally Manned Fighting Vehicle (OMFV) programme took a major step forward on 23 July 2021. On that date, the Army announced the selection of five competing firms to participate in the OMFV Concept Design Phase. The selected firms are American Rheinmetall Vehicle, BAE Systems, General Dynamics Land Systems (GDLS), Oshkosh Defense, and Point Blank Enterprises. The contract award for this phase has a total value of US\$299.4M, or an average of US\$60M per contractor.

The ultimate winner of the competition will go on to develop and build the OMFV as the replacement for the M2 BRADLEY Infantry Fighting Vehicle (IFV). The BRADLEY has received numerous upgrades since its fielding in 1982, and remains a powerful combat system. However, the Pentagon believes that it has reached the limits of its capabilities. The vehicle cannot accommodate additional technologies which are deemed decisive in order to survive and win on the future battlefield. An entirely new vehicle/



Oshkosh Defense will base its OMFV chassis on the Hanwha AS21 REDBACK.

weapon system is considered essential to maintaining the US Army's operational advantage. According to Army statements, the service is seeking a "transformational"

increase in warfighting capability rather than an "incremental" improvement in performance over the BRADLEY.

Capabilities and Characteristics

The BRADLEY replacement programme has suffered repeated setbacks over the past two decades. It took its current form in October 2018. The initial timeline and requirements released in March 2019 proved unrealistic, prompting the Army to reset the competition. The new programme guidance to industry was released in April 2020, superceding all previous directives to industry.

In contrast to the Army's 2019 requirements, the rebooted competition set only minimal initial demands regarding features and attributes of the new combat vehicle. These are not formally designated as "requirements" but as desired "characteristics." The nine objective characteristics defined in the December 2020 Request for Proposals are, in descending order of priority:





The C-17 can accommodate up to three M2 BRADLEY IFVs. The Army's most recent OMFV guidelines dropped the original requirement that at least two vehicles be simultaneously transportable via C-17.
Credit: Nielitite.

Survivability: The OMFV shall be survivable against modern direct fire, indirect fire, and blast threats. The OMFV should reduce likelihood of detection by minimising thermal, visual, and acoustic signatures;

Mobility: The OMFV must have mobility that can keep pace with the ABRAMS in a combined arms fight through rural and urban terrain;

Growth: The OMFV must possess the growth margins and open architecture required for rapid upgrades and insertion of future technologies such as mission command systems, protection systems, and sensors;

Lethality: The OMFV equipped platoons must defeat future near-peer soldiers, infantry fighting vehicles, helicopters, small unmanned aerial systems, and tanks as part of a Combined Arms Team in rural and urban terrain;

Weight: The OMFV must traverse 80% of Main Supply Routes (MSRs), national highways, and bridges in pacing threat countries, and reduce the cost of logistics and maintenance. Designs must allow for future growth in components and component weights without overall growth of vehicle weight through modularity and innovation;



Rheinmetall America Vehicles will present a design based on the LYNX KF41 IFV.

Logistics: The OMFV must reduce the logistical burden on ABCTs (Armoured Brigade Combat Teams) and must be equipped with advanced diagnostic and prognostic capabilities. Advanced manufacturing and other innovative techniques should be included in the design that reduce the time and cost of vehicle repairs;

Transportability: The OMFV must be worldwide deployable by standard interand intra-theatre sea, waterway, air, rail, and road modes of transportation; **Manning:** A platoon of OMFVs will transport 30 soldiers that dismount from the vehicles. Each OMFV vehicle will be crewed by

no more than two soldiers who will be po-

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ARMAMENT & TECHNOLOGY



OMFV partners Rheinmetall and L3 Harris emphasise the high-tech aspects of the LYNX.



BAE concept for the OMFV competition

sitioned in the hull. Squad members can perform crew duties prior to dismounting the OMFV but the vehicles must remain operational after dismounting. The OM-FV should allow commanders to choose between manned or remote operation based on the tactical situation and

Training: The OMFV should contain embedded training capabilities that are compatible with the Synthetic Training Environment (STE).

The lack of firm requirements allows industry to present concepts they considered realistic rather than tweak designs to the Army's prescription. At the same time contractors are free to present unconventional concepts. The Army has pledged to consider integration of "relevant but immature" technologies into design concepts.

Priorities

The Pentagon's one overarching directive is that the new vehicle must provide both greater occupant safety and combat power than the BRADLEY. OMFV is expected to accommodate new armour (including reactive armour and an APS or active protective system), offensive and defensive weapons potentially including directed energy weapons, and electronic systems (including advanced sensors, communications and networking, command and control systems, and electronic/cyber warfare capabilities). The Army expects that a combination of enhanced situational awareness (achieved through enhanced sensors and networking) and longer range precision weapons will enable the OMFV to identify and engage adversary combat vehicles before the opposing force detects the American formation.

As the programme designation makes very clear, the OMFV must provide the option of operating either with a human crew or remotely controlled by a dismounted crew. The crew will simultaneously be expected to operate external unmanned ground vehicles and UAVs. "It is designed to operate with or without a crew and soldiers under armour based on the commander's decision, while also controlling manoeuvre robotics and semi-autonomous systems," reads a 27 July 2021 US Army press release. One of the more challenging elements of the competition may be enabling a twoperson crew to handle all of these tasks. Several contenders in the previous OMFV competition considered this impossible, but anticipated improvements in artificial intelligence (AI) could eventually enable the fusion of the vehicle commander and gunner functions.

Tactical networking – the ability to tie individual combat vehicles and even their crews and passengers into a common tactical awareness network - is increasingly important for the future battlefield. Modularity – and especially the ability to continually upgrade the vehicles with the latest enabling technologies over the course of its projected 22-year service life - remains another key characteristic of the OMFV. For this reason, the Pentagon is developing an open architecture framework (Modular Open Systems Approach or MOSA) for the new IFV. This effort is running simultaneously with and parallel to the concept design phase. A consortium incorporating government, industry and academic participants was established in January 2021 to study and develop the open architecture concept. "We've shared our initial set of standards for the modular open system architecture with industry," said Brigadier General Glenn Dean, programme executive officer for Ground Combat Systems, during a July 2021 press briefing. "They are providing feedback to us, and we're iterating on that. That will close midway in this concept design phase so that those final standards can be incorporated into the design concepts that the contractors are completing."

Contenders

The Pentagon made a determined effort to reduce barriers to bids by foreign firms as well as small or non-traditional businesses. This is reflected in the downselect for the concept design phase.

American Rheinmetall Vehicle

As in the previous OMFV go-around, Rheinmetall is partnering with US-based Raytheon to present an OMFV concept based on the German LYNX KF41. Additional partners include L3Harris and Textron. L3 will provide vehicle mission systems and cybersecurity; the firm's modular open systems approach or MOSA will be incorporated into the OMFV design, simplifying upgrades as well as enabling cross-platform and cross-domain commonality of parts and subsystems. In February 2021, Rheinmetall added Allison as an additional partner to provide the vehicle with a "next generation electrified transmission."

Back in 2019, the US Army had viewed the LYNX favourably. The Rheinmetall/Raytheon team was one of only two competitors initially downselected for the design phase. Positive attributes were the passenger capacity of eight soldiers (one more than the BRADLEY), the extensive modular armour system, and the LANCE 2.0 turret featuring a 35mm gun (more powerful than the BRADLEY's 25mm cannon) as well as mission pods capable of deploying AT-GMs, reconnaissance UAVs, loitering munitions and an electronic warfare package. Rheinmetall was ultimately dropped from the competition only because the firm failed to deliver the required test vehicle by the October 2019 deadline.

BAE Systems

BAE Systems is partnering with Elbit for the OMFV programme. The firm has provided few details about its plans, but did release a photo on social media which appears to depict the chassis of BAE's Armoured Multi-Purpose Vehicle (AMPV) augmented with the Elbit UT30MKII unmanned turret. The AMPV (itself a derivative of the BRADLEY) was selected to replace the M113 armoured personnel carrier and is currently in low-rate production for the US Army. At this point, it remains unclear whether the released image is actually representative of BAE's new concept. The firm stresses the modularity of its future design, which would be capable of "rapid upgrades and technology refresh for quick insertion of new innovations or to counter emerging threats."

General Dynamics Land Systems

During the previous OMFV competition, GDLS submitted the GRIFFIN III, itself a derivative of the British AJAX family of vehicles. For the current competition, the firm is taking a different approach. Rather than submitting a preliminary design concept, the company plans to provide a flexible "approach" to the design process that will explore a wide range of options, stated Ray Kiernan, OMFV programme director at GDLS. "What we believe General Dynamics' role to [be] is to apply our tools to help the Army understand where the optimal solution lies" within the wide range of technical possibilities, Kiernan said during an April 2021 Breaking Defense interview.

The firm has promised to deliver a "next generation" design that will constitute a major leap beyond the BRADLEY while leaving sufficient capacity for future upgrades. For the OMFV competition, GDLS has partnered with Applied Intuition, a firm specialising in autonomy and simulated vehicle development. GDLS corporate sister General Dynamics Mission

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The GRIFFIN III is a derivative of the British Army's AJAX IFV.



The AS21 REDBACK IFV



The Australian Government in 2019 selected the Rheinmetall LYNX KF41 and the Hanwha AS21 REDBACK as finalists for the Land 400 IFV programme.

Systems is also involved, bringing in vital experience in battle management systems, cybersecurity, and sensor integration.

Oshkosh Defense

US-based Oshkosh Defense is teaming with South Korea's Hanwha Defense to present an OMFV concept based on the chassis of the Korean AS21 REDBACK IFV. The AS21 is itself a derivative of the K21 IFV which entered service with the ROK's army in 2009. The K21 carries nine passengers plus a three-person crew; turret armament includes a 40mm gun and ATGMs. The REDBACK variant is armed with a 30mm main gun and ATGMs. It has a 3+8 person capacity, and is equipped with an advanced

hydro-pneumatic suspension for superior cross-country performance. The situational awareness suite includes the IRON VISION system which allows the crew to effectively look through the hull; this would be particularly valuable while operating in close proximity with dismounted troops.

Hanwha entered the REDBACK in the Australian LAND 400 IFV procurement programme. The AS21 is one of two remaining contenders in the Australian competition, which will select the winner in 2022 (the other finalist is the KF41 LYNX). For the OMFV competition, Oshkosh plans to equip the AS21 chassis with a Rafael turret.

Point Blank Enterprises

The fifth competitor selected, Miamibased Point Blank Enterprises (PBE), is a dark horse. Unlike the other contenders, it is neither a major corporation nor an established vehicle design firm. Instead, PBE's five decades of experience centre on development of body armour as well as lightweight armour for vehicles, aircraft and ships. PBE is partnering with Keshik Mobile Power Systems as well as other, yet to be named firms including "large, experienced defence companies and a large group of innovative small businesses with advanced technologies," said PBE executive vice president Mark Edwards. The proposed concept will feature a distributed redundant hybrid electric drive train and a significant exportable electric power capacity. Keshick's chief technology officer Frank Jones stated that the design will be built around a "modular and technology-agnostic open systems approach for power, information, and physical architectures."

Parallel Programmes

OMFV is one of five armoured fighting vehicles currently being developed or to be developed for the US Army under the umbrella of the Next Generation Combat Vehicle (NGCV) programme. The other combat systems are: the Armoured Multi-Purpose Vehicle (AMPV) to replace the M-113 Armoured Personnel Carrier; Mobile Protected Firepower (MPF), a light tank to accompany Infantry Brigade Combat Teams; Robotic Combat Vehicles (RCVs) which will be procured in three variants, Light, Medium, and Heavy; and the Decisive Lethality Platform (DLP), a notional future replacement for the M-1 ABRAMS Main Battle Tank (unlike the other vehicles, DLP is not currently an active programme).

Caveats

The Army's Fiscal Year (FY) 2022 OMFV Research, Development, Test and Evaluation (RDT&E) budget request is US\$225M. For the 2022-2026 timeframe, the projected OMFV budget is US\$4.6Bn. The total programme cost, including research and development as well as procuring enough vehicles to replace the entire 3,800 M2 BRAD-LEY inventory, is estimated at US\$46Bn.

The high price tag of the programme, coupled with the tight defence budgets, which are expected to prevail over the next few years, could lead to delays in implementation, or to cuts in performance and procurement goals. "The Army budget will be squeezed and there will be intense competition for modernisation dollars," warned CSIS scholar Marc Cancian in an April 2021 interview with Breaking Defense. "OMFV will need to compete with all [35] Army development programmes and is not mature enough to have developed a broad coalition in Congress."

Cancian predicted that competing acquisition programmes such as long-range fires might be given budgetary priority, especially given the Biden administration's current emphasis on countering China. While the Pentagon insists that the vehicle will be relevant to all geographic theatres of operation, including the Indo-Pacific area of responsibility, some critics of the programme have guestioned whether the OMFV - or other heavy combat vehicles - are relevant for a conflict with China, given the distributed nature of the theatre. In this context, observers have noted that the Army has pushed "transportability" - which includes the ability to airlift the IFV - down to sev-



The Point Blank Enterprises concept sketch for the OMFV programme

enth place on the priority list. This could imply that the OMFV is being designed primarily for the European theatre, where lines of communications are shorter than in the Indo-Pacific, and where rail transport of military equipment is much more common.

Going Forward

The OMFV programme follows the Pentagon's standard five-phase acquisition framework. All but the final phase will be conducted as full and open competitions. The current 15-month-long Concept Design Phase constitutes phase 2, and runs through the second quarter (Q2) of FY23; the competitors will develop purely digital designs, based on existing vehicle/weapon systems but optimised for future require-



The OMFV will be augmented by various new fighting vehicles including fully robotic weapon systems. This photo shows the ORIGIN prototype robotic combat vehicle being tested in August 2020 with an ATGM and a remote-controlled machine gun.

ments. The models will be run through sophisticated simulations to determine what capabilities can be realistically expected. This phase will be marked by considerable back and forth dialogue between industry and the Army, said General Dean. "Some of that will include putting their concepts through modelling and simulation to demonstrate some of the operational value of some of those ideas. We, the government, will refine the requirements and specifications, feed that back out to the industry so they can update their concepts and repeat that cycle. There will be at least two cycles of requirements and specification updates back and forth with industry before the conclusion of the concept design phase at which point we expect the vendors to have highly refined concepts and be ready for actual design." Based on analysis of these outcomes, the Army will finalize the firm technical and performance requirements which will guide the competition going forward.

During phase 3 (Q2-FY23 through Q4-FY24), the Army will downselect to three contenders who will develop detailed designs; phase 3 culminates in a Critical Design Review (CDR). During phase 4 (Q4-FY24 through Q4-FY27) each of the three contractors will build 12 prototype vehicles, which will be tested by the Army beginning in FY26; Phase 4 will culminate in the production contract award to a single vendor. Phase 5 (Q4-27 through Q4-FY30) will see Low Rate Initial Production of 388 vehicles, quality testing of the first operational vehicles, and the decision to proceed to Full Rate Production (FRP). The first operational battalion is expected to be fully equipped by 2029, with FRP commencing in Q2 of FY30.

"To be better equipped and better armed"

Photo: DG/



With more than 10,000 employees, the French Direction générale de l'armement (DGA) coordinates armament projects with industry in France, within Europe, and also with customers for export. All in all, this amounts to more than a hundred major weapons programmes and operations in all areas of defence. The DGA also undertakes the testing and assessment of equipment and military technologies. In addition, the DGA supervises engineering schools that operate under the scrutiny of the Ministry of Defence. ESD had the opportunity to interview Joël Barre, Head of the DGA.

ESD: Can you briefly elaborate on the role, organisation and duties of the DGA? Is your organisation comparable to other defence procurement organisations like the Swedish FMV or the German BAAINBw? Are there other organisations involved in defence procurement in France?

Barre: The DGA is the French Government Armament General Directorate in charge of project management, development and purchase of weapon systems on behalf of the French Ministry for the Armed Forces.

The operational and technical departments of the DGA cover the same missions as the Swedish FMV or the German BAAINBw, meaning procurement and management of armament programmes but DGA is also responsible for additional missions. More precisely, the DGA has four missions: to equip the French military forces while preserving the national procurement sovereignty; to prepare the future of defence systems; to promote European cooperation; and to support the export of our military equipment. All these missions induce a strong industrial policy.

The DGA's workforce of 10,000 women and men, military and civilian personnel, working at one of its 18 sites, covers every domain of defence: land, naval and air combat, electronic communication and information systems, cybersecurity, robotics, deterrence, and space. In 2020, as the top investor of the French State, the DGA placed orders worth €13.8Bn with industry and invested €992M in defence innovation and technology projects.

Over the years, since its creation in 1961, the DGA has developed a unique knowledge in managing complex programmes. In most countries, these activities are conducted by separate entities within the Ministry of Defence. DGA's model is therefore peculiar. The centralised organisation of the DGA has been designed as a lever to conduct a sovereign and coordinated armament policy. This holistic vision is highly efficient in dealing with multi-dimensional issues, combining industrial policy strategies, international actions, future planning, procurement and programme management. Actions undertaken in the framework of European initiatives (PESCO, EDIDP, EDF) typically require such a combination of expertise. This is a major asset of the DGA.

ESD: What effects did the establishment of the Permanent Structured Cooperation pattern (PESCO) have on your organisa-



The DGA has been responsible for the execution of the BARRACUDA nuclear-powered attack submarine programme.

Photo: DC

tion's structure and work? What developments are to be expected in this context? Barre: The DGA considers that PESCO is an appropriate tool to develop cooperation in Europe at the governmental level. The cooperation developed in this context may lead to armament projects conducted in other collaborative frameworks, through dedicated multinational arrangements, and possibly with the support of the European Defence Fund (EDF). The past years have already demonstrated that this approach works. Thanks to PESCO, and in combination with the European Defence Industrial Development Programme (EDIDP), new governmental and industrial cooperation programmes have been established, for example in the domain of radio-navigation, to develop GALILEO receivers, which can be used by armed forces. The DGA has ambitious PESCO projects on the collaborative combat, materials and components, or detection and interception of missile threats. These PESCO activities, combined with the development of industrial solutions, have an impact on DGA. Since the launch of PESCO in 2017, the DGA has been strongly involved in its implementation. In coordination with the French military staff, the DGA has devoted specific resources and expertise for PESCO. As a result, the DGA is involved in 80 per cent of the 46 PESCO projects: it coordinates 11 projects, two jointly with another Member State, is a participant in 21 projects and observer in five projects. Through PESCO projects, the DGA cooperates with almost all EU Member States.

The DGA has contributed to shaping these new EU instruments, demonstrated success in implementing them, and will carry on learning and adapting to make the best



use of them. Now, the process has to demonstrate that the initiated projects really deliver results and are turned into industrial solutions.

ESD: To what extent does the DGA assume responsibility for the R&D component of armament programmes? Do you have your own R&D personnel?

Barre: To provide the French Armed Forces with efficient equipment in the short term but also to face the future threats, innovation support and R&D is also included in the DGA core activity. In 2020, the DGA paid €805M and invested €992M in defence innovation and technology projects and intends to reach €901M of payments and €1,174M of investments in 2021.

In 2018, Florence Parly, the French Minister for the Armed Forces, decided to create the Defence Innovation Agency - placed under the supervision of the chief executive of the DGA - in order to federate and coordinate all Ministry initiatives in the field of innovation, while pursuing long-term programmatic innovation works. Since then, DGA's departments and the Defence Innovation Agency work very closely together in order to turn the innovation concepts into assets within the programmes.

First, by orienting and piloting the scientific and industrial studies needed for tomorrow's capabilities. More than 100 technological projects with industry and 180 research projects with academic partners were launched in 2020, in a cross-feeding approach with DGA's long-term technological roadmaps.

The DGA also takes advantage of the ecosystem outside the defence sector: in 2020 for instance, 233 start-ups and SMEs from the civilian market were identified as being of defence interest by the Defence Innovation Agency. Valuable projects are tested and – if deemed satisfactory – are fast-tracked thanks to defence support provided to the companies: 127 projects from the civilian market were labelled in this way in 2020.

Regarding R&D personnel, the DGA and the Defence Innovation Agency have their own personnel for analysis, orientation and support. However, their workforce is enhanced via their collaborative work with national research and academic organisms such as CEA (the French nuclear and alternative energy research centre), CNES (the French centre for space studies), ONERA (the French aerospace lab) and ISL (the



The DGA has been supervising the FDI programme which aims at completing the HORIZON and FREMM frigate fleets.



The SCORPION programme is progressing with the well-established production of the GRIFFON vehicle.

French-German defence research institute) and the four engineering schools placed under the DGA's supervision.

ESD: Is the budget available for defence procurement exclusively provided from the defence budget of the Ministry of Defence, or can you also take advantage of other resources? How have procurement budget allocations developed over the past five years? **Barre:** The French defence procurement budget comes almost exclusively from the budget of the Ministry for the Armed Forces. Over the last five years, the procurement budget has increased by 25 per cent, from €9.9Bn in 2016 to €12.6Bn in 2020, in line with the Government's commitment to bring our global defence financial effort up to 2 per cent of GDP.

In addition, the Ministry for the Armed Forces can also take advantage of cooperative initiatives, such as the EDF. Together with PESCO, it forms a comprehensive defence package for the EU, aiming at financing the industrial R&D in the field of defence programmes. The total envelope is €7.9Bn over the 2021-2027 period. The DGA is fully involved alongside French industry in proposing eligible cooperative projects.

The other resources, such as royalty fees or expertise and test activities sold to external customers by the DGA's technical centres, are marginal (less than 0.5 per cent of the total procurement budget).

ESD: What are the most important defence programmes currently executed by your organisation?

Barre: The DGA conducts more than a hundred major weapons programmes and operations in all areas of defence: submarines, ships, satellites, command systems, airplanes, helicopters, missiles, armoured vehicles, land weapons, nuclear weapons, etc., with the aim of meeting the operational objectives and technical performance required by the armed forces.

In the field of combat aeronautics, the DGA is focusing on the development of the penetration, stealth and interoperability performance of the evolutions of the RAFALE and the preparation of the future air combat system, which will be linked to manned and unmanned aerial vehicles.

In transportation aviation, the DGA is pushing to ensure that the A400M completes the set of its tactical functions, in order to further increase its operational capabilities. In the naval field, the key point is the successful delivery of the BARRACUDA nuclear-powered attack submarine programme, the preparation of the replacement of the aircraft carrier and the next generation of nuclear-powered ballistic missile submarines. At the same time, the renewal of the first rank frigates continues, with the FDI programme, whose first-of-class will be delivered in 2023. It will complete the HORIZON and FREMM frigate fleets.

Regarding land forces, the equipment renewal initiated with step 1 of the SCOR-PION programme is progressing with the well-established production of the GRIF-FON vehicle and soon the delivery of the first JAGUAR and SERVAL vehicles. There are potential challenges for French-German cooperation around the "heavy tank" (MGCS) and "artillery" (CFIS) components. The air-land dimension is also considered with the extension of the fire support capabilities of the combat helicopter TIGRE and the launch of the Joint Forces Light Helicopter programme.

As far as the space domain is concerned, the DGA is entirely renewing the capacities with two new generations of satellites, the CSO family for observation and SYRACUSE for telecommunications. We are also about to gain a new capacity of electromagnetic monitoring, unique in Europe, with the CERES programme.

ESD: Which of your current programmes are carried out in international partnerships with other national or multinational procurement organisations? Are there defence procurement efforts executed in the scope of public-private partnerships?

Barre: Promoting cooperation is one of the four missions of the DGA. With the exception of sovereign areas such as deterrence, the DGA is now systematically looking for European cooperation opportunities for each operation. Currently, the DGA carries out numerous programmes with other European countries: the motorised capacity strategic partnership CAMO, in cooperation with Belgium in the land domain; the



The DGA is renewing its capacities with two new generations of satellites.

Logistic Support Ship (LSS) programme, in cooperation with Italy; the Maritime Mine Counter-Measures (MMCM) programme, in cooperation with the UK. In the air domain, the DGA is cooperating with Germany and Spain for the future combat air system (NGWS/FCAS - Next Generation Weapon System / Future Combat Air System) and with Italy for the anti-aircraft defence system SAMP/T NG. Regarding the space domain, the DGA is conducting the CSO observation satellite constellation programme with Belgium, Sweden, Italy and Germany. Finally, the secured software radio ESSOR has been progressing in cooperation with Italy, Spain, Finland, Poland and Germany. Furthermore, the DGA is strongly involved in the European initiatives such as PESCO, EDIDP and EDF. We cooperate with almost all Member States to foster competitiveness and sovereignty of the European Defence Technological and Industrial Base and ensure that these cooperation programmes deliver concrete results.

Regarding public-private partnerships, this solution has rarely been used by the DGA in the past and is less and less considered for new defence programmes.

ESD: Are there special regulations and procedures for the acquisition of nuclear weapons? Are such programmes also subject to competitive tenders?

Barre: The acquisition of strategic defence systems follows the same rules as conventional systems, in application of the French Code of Public Procurement Contracts. However, for reasons of sovereignty, the acquisition policy may lead to favouring French competitors for the weapons systems, with the possibility of open competition for constituent equipment. As with conventional systems, the sustainability of the defence industrial and technological base, as well as the maintenance of industrial skills over the long term, are issues for DGA's acquisition policy.

ESD: To what extent is the French defence industrial base capable of responding to the material requirements of the French Armed Forces? Are there areas where you have to rely on foreign contractors?

Barre: The DGA is responsible for preparing and implementing all the defence systems that allow France to ensure its independence and its strategic autonomy, as well as its freedom of decision and action. We must equip our armed forces at the highest technological level to ensure their operational superiority in their various operations.

Moreover, since France has the ambition to maintain a full-spectrum and balanced



The DGA is cooperating with Germany and Spain for the future combat air system NGWS/FCAS...

force model with mastered technologies, it needs a sizeable, strong and dynamic defence industry and technology base. The DGA ensures the rise in competence of its major industrial groups and small and medium-sized enterprises in the technological areas identified as priorities by the Ministry for the Armed Forces. In addition, the DGA makes sure of their ability to develop, produce and sustain in the long term the equipment our armed forces need to fulfil their missions. The DGA strictly applies this national line of action for the critical heart of the strategic domains. For the rest, the DGA can accept mutual dependencies with other Europeans States relying on the framework of the European Defence and Security Market Code, or even rely on the international market for non-strategic domains.

Most weapons systems of the French Armed Forces are the result of a virtuous triangular system between the DGA, the French forces and industry. However, French defence companies are largely globalised: their exports represent a significant part of their turnover and they purchase some intermediate goods from different countries, especially European ones.

At the same time, European cooperation has been developing. Quoting the President of the French Republic, Emmanuel Macron, in his official "Bastille Day" speech, delivered on 13 July: "to be better equipped, better armed, we are developing more and more cooperation, especially with our European partners". So, in order to equip the French Armed Forces and develop European autonomy in strategic areas, the DGA is also increasingly counting on cooperative weapons programmes, as I described previously, relying on the European defence industry.

The interview was conducted by Jürgen Hensel.



... and with Italy for the anti-aircraft defence system SAMP/T NG.

Global Navigation Satellite Systems

Thomas Withington

Satellite navigation systems are fantastically capable critical national and international infrastructure, but vulnerable. Fortunately, there is an alternative.

ot since its introduction in 1995 has tegrity of the US Global Positioning System (GPS). GPS is one of several Global Navigation Satellite Systems (GNSSs). Others include the European Union's (EU's) Galileo, the People's Republic of China's (PRC's) Beidou and Russia's GLONASS. GNSS has become essential for navigation over the past three decades. Aircraft, ships and vehicles all use GNSS to navigate. The US GPS constellation started life as a Department of Defence (DoD) project. As a result, US and allied militaries rely heavily on GPS technology. As a US government website discussing GPS explains "nearly all new military assets, from vehicles to munitions, come equipped with GPS."

GPS technology came to public prominence during the 1991 Persian Gulf War. As a US Air Force (USAF) discussion of GNSS during that conflict noted, the Navstar GPS constellation was in its infancy. 19 of the satellites were in orbit and the system was still four years from being declared fully operational. Operation DESERT STORM, the codename for the US-led coalition effort to evict Iraq from Kuwait, was the first conflict where GNSS was routinely used. Navstar aided precision bombing, artillery, ground forces manoeuvre, Special Forces, and combat search and rescue missions during the war. Thirty years later, the US and her allies have a total reliance on GPS.

GNSS Jamming

This is not lost on near-peer adversaries like Russia. As Rear Admiral (retired) Nick Lambert, co-founding director of NLA International notes, GNSS is a single point of failure. This is especially relevant in the civilian world. The vulnerability was un-

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An artist's impression of an early version of one of the US' NAVSTAR satellite. The constellation played a key role during Operation DESERT STORM

derlined in the UK Government's 2018 Satellite-Derived Time and Position, a Study of Critical Dependencies report. A myriad of business models and applications rely on the technology. From global logistics and telecommunications deliveries to stock market trades and even sports and exercise. Our global economy, people and organisations rely on GNSS for Position Navigation and Timing (PNT).

Alongside technology like laser targeting, GPS makes sure that weapons arrive on target, and units and platforms are where they should be. The Russian military took an important lesson. If they could disrupt GPS, they could disrupt the precision and tempo of US and NATO (North Atlantic Treaty Organisation) operations. The Russian Army has begun fielding GNSS jamming systems with its army Electronic Warfare (EW) units. These include the KRET RB-341V Leer-3 EW ensemble. This targets GNSS signals across wavebands of 1.1 gigahertz/GHz to 1.6GHz. The IL269 KARSUKHA-2 electronic attack system covers wavebands of one to two gigahertz. It may also have some utility against GNSS transmissions.

The integrity of military GPS signals is protected using M-Code. M-Code is an encrypted GPS signal only accessible by GPS-dependent End-User Devices (EUDs) which can decrypt the signal. M-Code signals are transmitted from satellites at higher power levels making them harder to jam. This gives US and NATO militaries some protection against GPS interference, real or unintentional. Nonetheless, what about non-military users dependent on GPS, or other GNSSs but without access to secure signals? Civilian users have routinely experienced GNSS jamming in the Baltic and eastern Mediterranean, and the South China Sea. The first two instances have been blamed on Russia. The country is believed to have deployed GNSS jammers to its base in northern Syria. The People's Republic of China has been accused of GNSS jamming in the South China Sea. Take the civilian shipping sector as an

example. The European Space Agency (ESA) funded Maritime Resilience and Integrity of Navigation (MARINAV) project primed by NLA International delivered its findings in March 2020. As noted in the UK government's 2018 report, the MARI-NAV project stated that the volume of sea-borne trade is expected to double by 2030: "GPS has become the primary marine aid-to-navigation and source of PNT information." At the same time, GNSSs are vulnerable to natural and deliberate interference. Taking the civilian GPS signal as an example it is easy to see why. The GPS satellites transmit a signal with 44.8 Watts of power. These signals have a long way to travel. GPS satellites orbit at an altitude of around 10,907 nautical miles/nm (20,200 kilometres/km). By the time the signals reach Earth they are very weak. This makes them easy to jam with relatively little power. It also leaves them prey to naturally occurring meteorological phenomena and terrain or building obstructions. These can degrade or block the signal

The MARINAV project initially focused on the United Kingdom's maritime critical national infrastructure. It looked at providing "resilient high-integrity PNT for ships and ports." MARINAV examined mainly terrestrial PNT technologies beyond GNSS. They needed to be capable of providing a ten metre/m (33 feet/ft) positional accuracy for ships approaching port. Their overall accuracy was required to be 20m (66ft). The PNT technologies were examined for possible use in the UK and Ireland's Exclusive Economic Zones (EEZs). One candidate technology examined by MARINAV was Enhanced Long-Range Navigation, better known as eLoran. As its name suggests, eLoran is a descendant of the erstwhile LORAN navigation system.

LORAN

LORAN was a radio navigation system developed by the United States during the Second World War. It exploited the fact that radio waves travel at the speed of light, 161,595 nautical miles-per-second (299,274 kilometres-per-second). LORAN was primarily used for air and maritime navigation. It used shore-based transmitters. These transmitted a single radio pulse on a frequencies of 90 kilohertz/KHz to 110KHz every half second. Each LORAN station had two transmitters separated from one another. Let us suppose we have a LORAN station with two transmitters positioned north and south of each other. They are separated by ten nautical miles (18.5km). If a ship with a LORAN receiver is positioned at the exact midpoint between the two transmitters, the halfsecond pulses from each transmitter will be received at the same time. The pulses from both transmitters will be in phase. If the ship is nearer the northern transmitter, the pulses will be out of phase. Pulses from the northern transmitter will reach the ship's LORAN receiver slightly quicker than those from the southern transmitter. By calculating the time lag between the northern and southern pulses, the ship can calculate its position relative to each transmitter. Given that the distance between the two transmitters (ten nautical miles) is known, all that is needed is a little trigonometry to show the ship's location. The ship is where the two axes from the northern and southern transmitters meet. Ironically, GNSS killed LORAN. As it became ubiguitous from the 1990s LORAN was gradually replaced. By the late 2000s it was largely phased out. Much as vinyl re-

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The Russian Army's 1L269 KRASUKHA-2 mobile electronic warfare system has been deployed to assist the force in jamming GNSS transmissions.

Photo: CC 3.0 License



An example of a LORAN transmitter, this one located on the island of Sylt, northern Germany. LORAN has largely fallen into disuse following the advent of GNSS.

cords have enjoyed a renaissance among hipsters, so LORAN is enjoying a new lease of life. Like today's records which are hugely improved from the discs of yore, eLoran is a substantial improvement on its ancestor.

eLoran

ELoran uses the same frequencies as LORAN, but that is where the similarity ends. A standard eLoran ensemble covering a specific area will use three transmitters a set distance apart. All three broadcast eight radio pulses, each with one millisecond of spacing. All these pulses will be broadcast by all three transmitters on the same frequency. As they use the same frequency all three transmitters cannot broadcast at once. The first transmitter broadcasts its group of eight pulses, followed by the second and third. The time delay between these transmitters broadcasting their pulses is called the Emission Delay (ED). Once the cycle of pulse broadcasts is complete, there is a time delay. The process then starts afresh. The delay between each cycle is called the Group Repetition Interval (GRI). Beyond the GRI and ED delays eLoran transmitters have a Signal Propagation Delay (SPD). The SPD is simply the time taken for the group of pulses to travel to the eLoran receiver on a ship, for example. If the ship is at the exact mid-point between all three transmitters, the SPD, GRI and ED will be the same. If the ship is nearer one transmitter, the delays will be shorter compared to the transmitters the ship is further from. By computing the time lag of these delays, the ship's eLoran receiver can calculate position with impressive accuracy. Simple eLoran receivers outfitting ships, aircraft or vehicles could perform this computation.

As eLoran transmits an accurate time source, it has applicability to other areas. For example, the financial world is an avid user of GNSS. GNSS provides an accurate time signal used to time stamp every stock trade. Any major disruption to GNSS signals, deliberate or otherwise on the City of London, for instance, even for a short period, could have major financial fallout. As eLoran transmits a time code, this could be used as an alternative time source. Another asset of eLoran is that the antenna to receive the signal would not need to be mounted on the roof of a building, as is the case with GNSS. eLoran signals can penetrate buildings. An antenna inside a bank's trading offices would be sufficient to receive the time signal. This is far less expensive to install, than a GNSS receiver on a building's roof. One of eLoran's most important advantages is signal strength. Trowbridge Littleton, president and co-founder of Hellen Systems says that by the time GPS' 48.8W signal reaches Earth it has a strength of one millionth of one billionth of a watt: "eLoran signals have a transmit strength of one megawatt. That is five million times more powerful than GPS," Mr. Littleton emphasises. An eLoran signal would need herculean power levels to jam making it difficult to attack. Moreover, the low frequencies of eLoran signals allow them to penetrate buildings, and some distance underground and underwater. Range is also important. He says that a single eLoran transmitter can have a range of 1000nm (1162km). A single group of five eLoran transmitters could cover the UK's landmass and her EEZ. This is particularly useful as it allows eLoran to provide PNT to land-based users.

While LORAN has largely fallen out of use, some of the existing LORAN infrastructure is still around. This could be co-opted into future national or international eLoran provision. In Europe, LORAN transmitters remain, albeit shut down, in France, Germany, Italy, Norway and Spain. Other stations exist in a similarly mothballed condition in Canada and the United States. Further afield stations can be found in India, the PRC, the Republic of Korea and Saudi Arabia. Nonetheless, Mr. Littleton concedes that new infrastructure will need to be built. This is driven by the requirements for the antennas to cover the areas of interest, where users need resilient non-GNSS PNT. That said, these costs would be significantly lower than those needed to build and maintain a space-based GNSS capability. That said, mobile eLoran units are available. Hellen Systems provides "our entire eLoran infrastructure in a standard shipping container," Mr. Littleton notes. This means that a portable eLoran system could be forward deployed to provide PNT in areas where GNSS coverage is unreliable, denied or unavailable.

Momentum

Some initial steps had been taken in Europe concerning eLoran. An eLoran transmitter was installed at the site of the Anthorn submarine communications transmitter in northwest England. Similar installations were established in Germany and Norway. However, this putative eLoran experiment came to an end. This was largely because of politics, one source familiar with the initiative told the author. During the same timeframe the EU's Galileo effort was gaining momentum: "Anything that implied GNSS was vulnerable was a complete no-no." As a result, this fledgling eLoran provision was dismantled.

The world is now waking up to eLoran's potential. Mr. Littleton says that ESA is interested in eLoran's applicability in the EU to provide both an alternative to GNSS and to supplement PNT delivered Galileo. There is also interest "in the Baltic and Central Europe." It would not be unrealistic to suggest that Russian GNSS jamming escapades may

take all these space and terrestrially derived PNT feeds. It would ascertain their respective margin of errors, and provide the most accurate, continuous PNT data as possible. "We should not be talking about global GNSS," he continues, "we should be talking about GPNTS – a Global PNT System. If we can provide accurate PNT using terrestrial systems, then we do not need to put more satellites into space. At the same time, we can use terrestrial PNT to augment and enhance GNSS improving the accuracy of that data. All these systems can be brought together to provide holistic, global PNT."



Hellen Systems has developed an eLoran system which can be accommodated in a standard shipping container, and deployed to wherever needed.

have piqued the interest of her neighbours vis-à-vis GNSS alternatives. As shown by the MARINAV report, the UK government is also interested in eLoran.

Conclusions

eLoran is not a panacea. It can be one of many technologies forming a global PNT 'system of systems'. Others could include everything from standard inertial navigation systems to automatic, visual, radar and celestial navigation. This approach provides redundancy, resilience and integrity. If one PNT system is degraded or unserviceable the others can pick up the slack. Having several technologies providing PNT enhances the overall accuracy and coverage of the user's timing and navigation data.

The trick, says Mr. Lambert, is to develop a "clever end user black box". This could

Mr. Lambert argues that we should not only be thinking about how reliant our global society and economy are on PNT today. We should also be assessing our increasing need and therefore reliance in the next few decades: "Climate change will drive a massive need for data gathering and analysis. These processes will also need robust, resilient PNT." Moreover, "the impact of Covid-19 has forced many of us to work remotely. This has increased out reliance on PNT," without many of us being aware of this. The pandemic has also seen a mushrooming of businesses relying on GNSS from meal delivery to vaccine logistics and online meetings. Your Zoom meeting needs a timing source, most probably derived from GNSS to run. Mr. Lambert urges us to think about what business models will emerge over the next 15 years. What will be their needs for resilient PNT?

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Military Mobile Decontamination Systems Examining the Main European Players

Dan Kaszeta

Decontamination is a core function in both military CBRN defence and civil protection against terrorism. In both missions, decontamination ("decon" in the industry's jargon) is the technical process by which threat materials on a surface ("contaminants") are removed and/or neutralised.

here are many components of decontamination technology and systems, which exist for vehicles and heavy equipment, people, and specialty purposes. This article examines so-called "mobile decontamination" systems. Although specialist definitions may vary, for the purposes of this article, such systems are defined as vehicles, trailers, or containers and skid systems designed to be fitted onto trucks, specifically intended to provide personnel or equipment decontamination for military or civil missions. One can argue that such skid or container systems are not "mobile systems" but many are designed specifically to fit onto the user's existing fleet of trucks. Indeed, such systems are the heart of the military mobile decontamination business. It should be noted that large mobile systems tend to sit at the top of deep product lines involving smaller elements and components, many of which are useful products in their own right for smaller missions.

A brutal commercial truth in the military CBRN defence market segment is that mobile decontamination systems are large, expensive, and long-lasting. If well maintained and not overworked, such systems can often last for many decades. Decontamination systems procured by the US Army in the 1980s soldier on. Others atrophy from under-utilisation, as scenarios requiring their use are thankfully scarce. As such, this sector of the market often lacks major contracts for months or years at a time.

<u>Author</u>

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Republic of Korea airmen perform a CBRN decontamination operation at Osan Air Base in South Korea in March 2015.



Vehicle Decontamination

Mobile decon systems generally address two particular operational requirements. The first is vehicle and heavy equipment decontamination. A bit like a mobile carwash, large decon systems set up decontamination stations which wash down major military vehicles like tanks, trucks, and artillery pieces. While myriad chemical products are available from the various manufactures, soap and warm water are often the mainstays of this mission. The other main mission is personnel decontamination. While this may sound sophisticated, for most purposes this means "take a warm shower with some soap", and many mobile decontamination systems are quite popular in major exercises because they represent warm showers to tired and dirty soldiers.

The Market

Most of the decontamination market has historically faced competition from generic equivalents. In the civil protection market, mobile decontamination systems are up against serious generic competition in the form of firefighting apparatus. Fire engines have long been used for both improvised and specialist decontamination tasks.

While it is taken as truth by many that the United States drives the world's military CBRN market, mobile decon systems is certainly an area where European companies are serious players. Any serious analysis of this market segment in Europe will always come back to three main firms, one Italian and two German. Cristanini (Italy), Kärcher (Germany), and OWR (Germany) are the main pillars of large, mobile decontamination systems in the EU. It should be noted that all three firms are not just manufacturers of ma-



Cristanini`s RI/CBRN trailer



The Cristanini "Tactical Multi-mission Air-transportable Vehicle" (TMAV) is a multi-role decontamination and firefighting vehicle.

jor decontamination systems, but smaller systems, accessories, and chemical solutions for decontamination, as discussed in previous issues of this magazine.

Christanini

Taking them in alphabetical order, Cristanini S.p.a. is located in Rivoli Veronese, near Verona, Italy. Founded in the early 1970s, Cristanini still strongly bears the imprint of its founder, Adolfo Cristanini, who has been a fixture at many trade shows and exhibitions for decades. Cristanini works in connection with the University of Padua to keep its technologies up to date. The author has visited the Cristanini plant several times and it is an impressive operation. Like its two German rivals detailed below, Cristanini serves other sectors of the decontamination market as well as more conventional cleaning and spraying markets.

Working from smaller to larger, the "Light Decon Trailer" is based on Cristanini's smaller Sanijet and Sanigun systems. As





Kärcher's TEP-90 integrates a crane arm which can serve as a platform for a decontamination specialist to spray water or decontamination solutions.



Kärcher`s Decocontain 3000 is based on a 20-foot cargo container.

the name suggests, it is a light trailer (1385kg fully loaded) that could be pulled by virtually any reasonable military vehicle. One person can operate this system to perform vehicle or equipment decontamination operations with its high-pressure hot water spray. It can also fold out to provide a single shower lane, with warm water and appropriate pressure for personnel decontamination. The next step up in the product line is the 2200kg "RI/ CBRN trailer." It is longer and higher capacity than the Light Decon Trailer. This system has a rated capacity of up to 12 vehicles per hour, although this will definitely depend on size of vehicles. It can support an optional inflatable decon tent for stationary personnel decon of up to



120 persons an hour. Interestingly, it can also be pulled to support terrain decon, deconning a 5-meter-wide lane at about 4 km per hour, if water supply is topped up. Moving up from trailers to full-size vehicles, the Cristanini TMAV "Tactical Multi-mission Air-transportable Vehicle" is a multi-role decontamination and firefighting vehicle. It is a 4x4 truck, which can fit on a C-130J cargo aircraft. With a "cherry picker"-style aerial platform and the Sanigun system, it can decontaminate 3 aircraft or 6 vehicles per hour. Like the trailers, it can operate in stationary mode as well for personnel decon, with a foldable tent. In this mode, it can decon 25-30 people an hour. As additional non-CBRN missions often help customers make buying decisions, the TMAV is also useful for aircraft de-icing and some firefighting roles.

The DDMAS represents Cristanini's largest mobile system. A critic would argue that the DDMAS is not a mobile on its own. However, it's a full system skid specifically designed for either temporary or permanent mounting on a military cargo truck chassis. It has the telescoping arm of the TMAV. One operator can decontaminate from the arm and another can decontaminate from ground level. As with the other systems, personnel decon is supported by tented systems. The DD-MAS has enough pumping infrastructure to support several decon tents. It can also support firefighting operations, terrain decon, and even undercarriage decon of vehicle chassis.

Kärcher Futuretech

Moving on to Germany, Cristanini has not one, but two competitors in this space. Kärcher Futuretech is based in Schwaikheim, Germany. Many readers may be familiar with Kärcher pressure sprayers and pressure washers for civilian use. Their military business extends to water purification, mobile catering, and mobile camp infrastructure. But within military circles, the Kärcher name is well-known in military CBRN decontamination.

Two products form the core of Kärcher Futuretech's mobile decontamination line-up. Both are container-based systems, designed to be installed on any military's standard light or medium cargo truck platform. The smaller of their two systems is based on a 10-foot cargo container. Weighing 4000 kg with an integrated generator and 1000 litre water supply, the DSVP 10C can fit on numerous different military vehicle platforms. This system can be put into operation

Photo: OV

within minutes. It can be operated by a small crew and is capable of operating for one hour before needing more water. In that time, it is rated for decontaminating 19 people, 2 vehicles, or 150-200 square metres of terrain.

The much larger Decocontain 3000 is based on a 20-foot cargo container. Fully loaded, it weighs 12000 kg, much of it from the 2700 litres of water storage. It can be operated by 8 decontamination specialists. It takes less than 20 minutes to set up for full operation. It can support decontamination of up to 160 people or 8-12 vehicles, depending on size. This raises a valuable point. The answer to the question of what number of vehicles per hour can be decontaminated will vary greatly in practice. A LEOPARD tank, a PATRIA APC, and a Landrover will all have guite different surface areas and take different times, regardless of which vendor made the decontamination apparatus. This system is in military use in at least Sweden, Singapore, the UAE, Oman, Spain, and Kuwait.

Another Kärcher product offering is the TEP-90. Not dissimilar to the Decocontain, it is based on a 20-foot container but also integrates a crane arm which can also serve as a platform for a decontamination specialist to spray water or decontamination solutions. Israel is known to possess the TEP-90 and it serves with the CBRN troops of the Bundeswehr.

It is also worth noting Kärcher has a specialty mobile decontamination system called the DSSM. This system is also based on a ten-foot container. It is designed for the more specialised task of decontaminating personal equipment such as helmets, body armour, and weapons, as well as sensitive equipment like electronics. The DSSM uses either vacuum chambers or hot gas decontamination, depending on the material to be treated. This system is in use with the Germany military.

OWR

The other big German name in this market is OWR, which is short for Odenwaldwerke Rittersbach GmbH. They are based in Elztal-Rittersbach. OWR has long been a rival to Kärcher and Cristanini in the global CBRN decontamination space. As with the others, OWR makes a variety of smaller systems as well. They are well known in this space for their GD-6 decontamination agent, mentioned in previous issues of this publication.



OWR's MPD-100 can decontaminate up to 5 main battle tanks, 10 trucks, or 20 light vehicles per hour.

OWR's primary contribution to this market segment are the MPD-100 and MPD-109i. The MPD-100 is based on a 20-foot cargo container and works either as a roll-on/ roll-off system or permanently integrated into a truck platform. The MPD-100i is an improved version with more capacity. The MPD-100 can be operated by as few as 3 operators, although throughput is enhanced by a larger crew. This system is designed for all of the major types of military CBRN decontamination and can operate with both specialty and generic decontamination chemicals. (To be fair, so can the other manufacturers' systems although this is often not advertised.)

The MPD-100 and MPD-100i have fairly impressive throughput specifications. The MPD-100 decontaminates up to 120 personnel an hour (double that in the MPD-100i). Various options and accessories make casualty decontamination possible as well. Unlike some of the other manufacturers, OWR breaks down the figures on vehicle decontamination by class. It claims up to 5 main battle tanks, 10 trucks, or 20 light vehicles per hour. Terrain or infrastructure decontamination (such as runways) is rated at 6,000 square metres per hour. It should be noted that OWR also made a smaller, trailer-based decontamination unit but it is not in the current product line-up on their website. Their legacy systems are well supported for decades, however.

Smaller Players

Although these three are the most prominent players in the European CBRN space it is important to note that there are some other manufacturers, who often serve their own domestic defence markets. Their success in export markets is quite variable. Excalibur Army (CZ) produces their Decon vehicle, based on a Tatra 4x4 truck. It features a 2 man boom lift platform. NBC-Sys (France, now part of NEXTER) has the "Dekvoz" which has seen service in the Slovak army. Their "Symoda" is designed for aircraft decontamination, and their "Meerkat" is a small decon vehicle, designed for small missions like one vehicle or 5-6 personnel. A Polish consortium produces the "APIS-2" decontamination vehicle and won a contract to deliver 26 to the Polish military. Hotzone Solutions (NL) advertises that it can modify vehicles and adapt them for decontamination use. Utilis (France) and Hispano-Vema (Spain) have various container-based products which don't quite match the threshold for this article.

To a greater or lesser extent, requirements by customers often necessitate a reasonable degree of customisation. All of the major vendors described above do modifications to allow their systems to fit onto vehicles or even integrate their systems onto specific vehicle platforms. There is enough expertise in these companies that they would generally be competent to make specialty or bespoke systems for a particular agency or national requirement.

Outlook

Where does the future lay in this segment? It is this author's professional judgement that it is actually quite hard to tell. At the end of the day, CBRN decontamination in such large roles is as much about putting warm soapy water onto the problem as it is about anything else. The products and technologies are all mature. Future development in this market will largely be a matter of militaries taking the CBRN threat more seriously or not. If they do, then there will incremental growth in this sector.



Viewpoint from New Delhi



From Saigon to Kabul

Suman Sharma

With America's unceremonious exit from Afghanistan being widely viewed as a humiliating defeat for the US-led NATO forces, and with UN-designated Taliban terrorists sworn- in to power, the US seems to have learnt little from its past misadventures. From Saigon to Kabul, Washington has been criticised time and again for importing its own style of democracy and then quitting haphazardly, creating chaos. The 13 US Marines killed in a suicide terror attack at Kabul airport during the evacuation process, which saw thousands of Afghan nationals being flown out of the country, triggered global criticism for America's misplaced confidence.

Indian Army's Lt. Gen (Retd) BK Sharma says, "While the US military is good in shock and awe or conventional conflicts, it has been found wanting in insurgencies and counter-terrorism. As if lessons from Vietnam, Somalia, Iraq, Syria and Lebanon were not enough, the undignified exit from Afghanistan has conclusively established American ineptitude to deal with asymmetric conflicts."

Reminiscent of the April 1975 evacuation of US troops from Saigon after a bloody 20-year war, the messy retreat from South Vietnam demonstrated the fall of a superpower and its enormous war machine. The poorly executed departure from Afghanistan has drawn similar comparisons globally which has come to be famously referred to as the 'Saigon moment'. The image most likely to remain in the memories of security watchers is the American Chinook helicopter hovering over the US embassy in Kabul, quite similar to the chopper over the US embassy in Saigon signalling the end of the Vietnam War.

One must not forget other comparisons, like 500,000 US troops, of which approximately 58,000 were casualties in Vietnam, while in Afghanistan, out of the roughly 100,000 troops deployed, 2,300 were killed in action. About four US aircraft carriers, along with 28 ships were used in Vietnam for the evacuation, while in Afghanistan the C-130J SUPER HERCULES and the C-17 GLOBEMASTERS flew for 17 days to evacuate about 120,000 US military, US citizens and vulnerable Afghan nationals.

US Secretary of State Antony Blinken testified on Afghanistan before the US Congress' Foreign Affairs Committee, defending the hasty withdrawal on the grounds that it would have had the same effect irrespective of when it was carried out.

Iraq, Libya, Syria

The arming of the Mujahideen in the early 1980s to fight against the Soviet occupation only pushed the once free and modern Afghanistan into a civil war after the Soviets quit in 1989, giving rise to the present-day Taliban partnered by the Haqqani network, and which gave safe haven to the globally blacklisted Al Qaeda which masterminded 9/11. Many marginalised smaller terror groups in and around Afghanistan like the ISIS-K, JeM (Jaish-e-Mohammed), LeT (Lashkar-e-Tayyaba), Daesh, IMU (Islamic Movement of Uzbekistan), IRTP (Islamic Renaissance Party of Tajikistan) and Salafiya group of Tajikistan have all sprung up.

After its eight-year long occupation of Iraq, which began in 2003, the US pull-out after the disbanding of Saddam Hussein's regime, the remnants of the Iraqi army gave rise to the deadly global terror outfit - ISIS. It is widely believed that the instability and disarray that ensued after the pull-out, plunged Iraq into chaos, thereby rendering the country leaderless and emboldening the begrudged Iraqi army-turned ISIS.

The seven-month military intervention of Libya in 2011 was not just heavily criticised by world leaders, but also by NATO allies such as Italy, which did not back the intervention. The campaign ended with Libyan dictator Muammar Gaddafi's assassination, leaving the nation in mayhem, which continues to this day.

The American-led mediation in the Syrian civil war in 2014 was basically to back and arm the Kurdish rebels against ISIL, a move opposed by NATO member Turkey, which wanted to attack the Kurds. The American decision to withdraw from northern Syria in 2019 was seen as letting the Kurds down who felt stabbed in the back.

Barring the short Gulf War of 1991, where the sovereignty of Kuwait was restored following the Iraqi invasion, America cannot boast of any other success in the post WW-II era.

America's strategic myopia, resulting in its profligacy of trillions of dollars in pursuit of its hegemonistic ambitions worldwide, has only divided Americans over issues such as forced conscription, increased taxes, diversified allies, and criticism over American-led wars, which have given rise to new terror groups.





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India Joins Elite Club of Aircraft Carrier Manufacturers

Suman Sharma

"An aircraft carrier is 100,000 tons of diplomacy", Henry Kissinger once said. In this sense, India's first IAC (Indigenous Aircraft Carrier) INS VIKRANT sailed into history last month as she was launched for sea trials, thereby catapulting India into the elite club of nations owning the niche technology to design and construct an aircraft carrier.

he 40,000-ton reincarnated INS VIKRANT, named after India's very first aircraft carrier acquired in 1961 from the UK and decommissioned in 1997, successfully completed her five-day maiden sea voyage in south-western India. The other carrier-owning navies of the world are the USA, France, UK, Italy, Russia, and China The vessel is expected to be officially commissioned into the Indian Navy in 2022, coinciding with India's commemoration of the 75th anniversary of independence. It is expected that the VIKRANT will be fully operational by mid-2023 after the integration of its air element, following the trials of Russian MiG-29K fighters and the indigenously produced advanced light helicopters.

Constructed with a budget of US\$3.15Bn under the codename Project-71, INS VIKRANT has 76 per cent indigenous content and has been designed by the Indian Navy's DND (Directorate of Naval Design) and constructed by the Indian Government-owned CSL (Cochin Shipyard Limited), under the Ministry of Shipping. The VIKRANT has proven to be the shining beacon by giving a big push to India's "Atma Nirbhar" pitch pioneered by Prime Minister Narendra Modi. This is CSL's and the Indian Navy's premiere attempt at carrier design and construction.

The carrier's power generation and propulsion worthiness have already undergone testing at harbour as part of basin trials in November 2020, after which the sea trials ought to have begun, but the delay is attributable to the second wave of the COVID-19 pandemic. The dedicated efforts of engineers, OEMs, designers, inspectors, overseers and the ship's crew have more than made up for the delay.

The indigenous construction has accelerated the growth in indigenous design and construction capabilities besides developing a large number of ancillary industries, leading to the creation of employment opportunities for 2,000 CSL personnel and about 12,000 employees in ancillary industries. Over 76 per cent indigenous content towards procurement of equipment, besides work by CSL and their sub-contractors is being directly invested back into the Indian economy. Around 550 Indian firms, including about 100 MSMEs (medium small and micro enterprises) are registered with CSL, who are providing various services for INS VIKRANT.

On her maiden sea trial voyage off Kochi, the VIKRANT's performance, including the main propulsion, hull, auxiliary equipment and PGD (power generation and distribution) were tested and proven successful. After the VIKRANT's launch, trials have been progressing as planned to test the systems' parameters. The carrier would continue to undergo a series of sea trials to prove all equipment and systems prior to handing the vessel over to the Indian Navy in 2022, after which the Navy will conduct the air element integration and operationalisation. The initial trials are being conducted by the shipyard.

Indian Navy's former Chief of Naval Staff Adm. Sureesh Mehta (Retd) says, "This project has been going on for a long time. We started by building smaller ships, then big ships and now we have gained the ex-





The construction of INS VIKRANT came at a cost of US\$3.15Bn.



INS VIKRANT is India's first indigenously built aircraft carrier.

pertise to build a carrier. It's important to be self-reliant, as not everyone sells you a carrier, then we have to settle for a second hand one in which the cost goes up as part of the refit."

Viewed as historical and a major milestone, the IAC's delivery is likely to strengthen India's position in the IOR (Indian Ocean Region) and its quest to become a blue water Navy.

Strategic Reach

Former First Sea Lord of the Royal Navy Admiral Sir Mark Stanhope, has said, "To put it simply, countries that aspire to strategic international influence have aircraft carriers." Realising the importance of aircraft carriers having strategic influence and the extended reach, countries like Brazil, Japan, Australia, Egypt, South Korea, Turkey who operate helicopter carriers are aiming for fixed-wing integrated ones, with Japan surging ahead with its F-35B integration programme on board the IZUMO class helicopter carriers.

Indian Naval aviator Vice Adm. Shekhar Sinha (Retd) says, "A carrier is the biggest power projection tool and extends your reach, helps in support, action and projection. India has a primacy in naval power among the littoral neighbours in the IOR. Smaller countries are influenced by both soft and hard power which China uses, but China will take time for operational competence, as imbibing carrier aviation and having it are two different things. India has been operating a carrier since 1961 and China started much later."

From the days of WW 1, the influence an aircraft carrier can have over the outcome of a war was well understood, as demonstrated with Pearl Harbor in WW 2.

Being the largest navy in the IOR, India has time and again exhibited its power both in peacetime and conflict, as the old, decommissioned INS VIKRANT expedited East Pakistan's surrender in 1971 or the now decommissioned INS VIKRANT deployed at the Makran coast south of Pakistan during the Kargil conflict. During the end of the Cold War, India responded to former President J Jayawardene's call for carrier deployment off Sri Lanka.

With 29 IOR and 23 IORA (Indian Ocean Rim Association) states, only India operates a carrier and therefore carries the responsibility of being the first responder and has thus demonstrated as such, especially for maritime assistance operations and rescue missions. The IOR states, being scattered in the region, make an aircraft carrier the preferred security platform for human assistance, disaster relief, rescue operations, medical help, evacuations and security patrols. It is great for messaging in the IOR.

Prime Minister Narendra Modi first spoke about SAGAR (Security And Growth for All in the Region) in Mauritius in 2016, a maritime policy which channels itself through regional groupings like ASEAN, BIMSTEC, and IORA.

China

While China has already acquired two aircraft carriers, there are reports that the third one is almost ready for launch. According to reports, China aspires to launch a CBG (Carrier Battle Group) in the region with one more being added by 2028, thereby upsetting the regional power balance. Beijing also aims at having ten carriers by 2050.

The Indian Navy has been persistent in its demand for three carriers, one for each

seaboard, as it aspires to be IOR's net security provider and to counter China which has reportedly increased patrols in the IOR. Indian Naval Chief Adm. KB Singh has projected the Indian Navy's strategy to carry out CBG supported operations.

The second indigenous aircraft carrier, the 65,000-ton IAC-2, to be christened INS VISHAL, with a CATOBAR system is still in the planning stage. This will be the Indian Navy's largest warship which fits well into the overall operational strategy. Delayed due to funding issues, the Indian Navy has done away with the nuclear propulsion to bring down INS VISHAL's cost from approximately US\$13.6Bn down to US\$6.1Bn. Aircraft carriers find a place in today's asymmetric warfare, like it had in former times of maritime diplomacy. Carriers are being used by militaries the world over as deterrents owing to their precise and fastpaced military power projection in limited localised combat scenarios.

INS VIKRANT's Specifications

The 40,000 ton IAC INS VIKRANT is 262 m long, 62 m wide and has a height of 59 m, including the superstructure. There are 14 decks in all, including five in the superstructure. The ship has over 2,300 compartments, designed for a ship's complement of around 1,700 crew members, including specialised cabins to accommodate female officers. The ship has been designed with a very high degree of automation for ship navigation, machinery operation and survivability. VIKRANT has a top speed of around 28 knots and a cruising speed of 18 knots with an endurance of about 7,500 nautical miles. The ship can accommodate an assortment of fixed wing and rotary aircraft.

Italy's Defence Multi-Year Planning Document 2021-2023

Luca Peruzzi

Italy just released a new budgetary plan for funding its military which sheds light on the country's procurement priorities.

BAE System

he release of the Italian MoD's Multiyear Planning Document 2021-2023 (Documento Programmatico Pluriennale or DPP 2020-2022) in August, anticipated by a dedicated directive on the national defence industrial policy by the Italian Minister of Defence Lorenzo Guerini, highlighted the highest funding support for the defence sector since the mid-2000s. The funding, worth€28.28Bn, combines the ordinary budget, participation to international missions, other Ministries' funding and the 'fund related to the multi-year investment programmes for defence missions. In the following two years, the overall budget is set to decrease respectively to €27.5Bn and then to €24.26Bn. As highlighted by the Italian Minister of Defence, the DPP 2021-2023 includes the launch of 85 new procurement/modernisation programmes and the updating of the 115 on-going programmes. Among them, seven have been declared as strategic. These include: the sixth generation TEMPEST 'system of systems' programme; the Defence cloud concept; a new amphibious vehicle; enhancement of air and antiballistic defence (BMD); new radars for air defence missile systems; new air defence destroyers; and participation in the Armoured Infantry Combat System (AICS). All are considered as being open for potential international cooperation, high-tech value and national industrial involvement and return. These will be covered by the multi-year funding plan for national defence indicated in the Parliament bill authorisation for 2021.

Air Programmes

Following the trilateral agreement (UK, Italy and Sweden) on the launching of the development activities for the 6th generation TEMPEST combat aircraft system programme signed last December, the DPP 2021-2023 includes the first tranche of funding to participate in the research and development (R&D) phase. The Italian MoD put aside \in 2Bn in funding for these activities, which are expected to require a total of



The Italian MoD has so far allocated €2Bn for research and development activities related to the TEMPEST combat aircraft. Italy, Sweden and the UK signed a trilateral development MoU last December for the 6th generation aircraft.

€6Bn for the Italian side. This allocation of funding for the TEMPEST programme R&D phase comes within the DPP 2021-2023 with more resources for the EUROFIGHTER programme and the "technological evolution" toward the 6th generation platform. During the DSEI 2021 exhibition, Leonardo announced the participation of Italian industry to the development of the new European Common Radar System Mark 2 (ECRS Mk2) radar for the same platform launched by the UK, following a 'Statement of Principles' document signature by the two Ministries of Defence

The new DPP also confirms the plans for the procurement of 90 platforms within the F-35 JSF multi-year acquisition programme. In addition to the 'Phase 1' regarding the acquisition of first 28 aircraft between A and B versions for both the Italian Air Force and Navy, engines, retrofit, support until 2022, Cameri assembly and support line establishment, air bases and Cavour aircraft adaption for an overall €7.05Bn, the DPP acknowledges a Phase 2A for the procurement and enhanced support for 27 platforms for an overall value of €4.2Bn and a Phase 2B for which preliminary contractual activities are planned to be concluded in 2022 for the procurement of the third tranche of platforms (35 aircraft) and support, valued at €7Bn. The programme was compressed to reduce costs (saving of about €1Bn according to the DPP) and for the quicker achievement of the full operational capability by 2030. The new phases funding is subject to adjustments connected to the periodic international procurement activities by the F-35 JPO.

The other main airborne programmes announced by the latest DPP regarding the European MALE (Medium Altitude Long Endurance) RPAS development, procurement and support programme, the upgrading of the MQ-9 fleet and the replacement of the MQ-1 fleet. The Italian MoD put aside €1,9Bn of the ordinary budget for the European MALE programme, waiting involvement next year of the Ministry of Economic Development funding. In the meantime, the in-service MQ-9 fleet will be upgraded and for the first time, the Italian MoD acknowledges the programme for weaponising these platforms for an overall funding amount of €168M of which €59M has already been allocated. The programmes for the procurement of new GULFSTREAM G550 platforms to be equipped with CAEW, Electronic Combat and SIGINT mission suites, continues in the meantime.

The Italian Air Force will also see the completion of development and procurement programmes for the EW mission suite dedicated to the C-27J JEDI platform, together with the funding of the C2 and weaponised mission module to equip the first C-27J PRAETORIAN dedicated to Special Forces operations. The transport segment will also see the procurement of two additional KC-767 transport/ tanker aircraft in addition to the upgrading of the in-service four platforms for an overall value of €1.4Bn and the launch of the C130 Mid-Life Upgrade programme.

Among the joint armed forces programmes, the DPP acknowledges the soon-to-be launched programme for the ballistic missile defence capability acquisition. It includes the procurement of four long-range surveillance radars and six batteries with dedicated effectors, C2 and multifunction radars for an overall value of €408M. This in addition to the announcement and funding of five new batteries for the Italian Air Force of the SAMP/T NG air defence missile system, being developed by Eurosam for the Italian Army and the French Air Force with the participation of Thales and Leonardo.

Navy and Joint Programmes

With the DPP 2021-2023, the Italian Navy is registering the launch of multiyear programmes for both the procurement of new ships and the upgrading of in-service platforms. The Italian MoD has approved the development and procurement of two new generation air defence destroyers under the so-called DDX programme to replace the aging LUIGI DURANTE DE LA PENNE class vessels. In addition to air and ballistic missile defence systems with long-range radars and effectors, the new destroyers will also be equipped with anti-ship and deep land-attack weapon systems. The overall funding request is for €2.7Bn of which €1.49Bn will be allocated to preliminary

The Italian MoD approved and allocated initial funding for the development and procurement of two new generation air defence destroyers under the so-called DDX programme.



During DSEI 2021, Leonardo announced Italian participation in the ECRS Mk2 radar programme for the EUROFIGHTER TYPHOON launched by the UK in September 2020.

studies and initial procurement. A feasibility study is expected to be assigned to Fincantieri by year-end. The DPP also includes the allocation of first \in 170M for funding the DORIA class (HORIZON type) MLU, whose feasibility study is being conducted jointly by OCCAR on behalf of the Italian and French navies. The Italian MoD is also set to launch the procurement and in-service support programme for two additional VULCANO class logistic support ships for a total of \in 823M of which \in 232M is already allocated. In order to replace the current fleet of aging smaller patrolling platforms, the Italian



The Italian MoD multi-year programming document 2021-2023 includes the procurement and in-service support programme for two additional VULCANO class logistic support ships, in addition to the first-of-class delivered earlier this year.

Defence Ministry launched the procurement of eight new generation OPVs for an overall programme estimated value of €3.5Bn of which initial de-risking studies for €5M are allocated. The development and procurement is planned to be conducted under the EPC (European Patrol Corvette) programme, together with at least France and Spain. Among the new joint armed forces programmes, the Italian MoD has approved the development and procurement of a new J3MS naval intelligence/special purpose platform with an allocated €470M in funding. The DPP also includes the initial funding for the de-risking studies regarding the new generation mine counter-measures vessels equipped with dedicated unmanned vehicles (12 units of seagoing and coastal types) and new amphibious ships (LXD) to replace the SAN GIORGIO and SAN GIUSTO class platforms in the longer term. This is together with procurement funding for a new multirole platform for underwater EOD and materiel recovery from the seabed in support of Divers and Special Forces Command (COMSUBIN). In parallel, a contract for a new special forces/divers support and submarine rescue ship (SDO-SuRS) is expected to be assigned to the selected Mariotti shipyard in the second half of this year. The Italian MoD has already launched a tender for the procurement of new tugs to be sided



With the DPP 2021-2023 document, the Italian MoD acknowledged the expansion of the SAMP/T NG programme for the Italian Air Force in addition to the Army for five new frontline batteries.

by smaller support vessels for harbours and sea-going operations, while a programme for fourteen platforms dedicated to coastal logistic and lighthouse support is due to be launched in 2023. This is in addition to a €46M programme for the procurement of RHIBs/Rigid Raiding Crafts to equip both the Italian Navy and Army's amphibious forces. The Italian MoD has also approved the programmes for the mid-life update of EH-101 helicopters and studies regarding new naval unmanned platforms to operate from in-service and future platforms. The DPP acknowledges the launch of the massproduction programme for the VULCANO family of naval long-range guided munitions, while procurement is to be launched by 2022 for Leonardo's DART guided munitions and Rheinmetall's 130 mm combined RF/IR BULLFIGHTER decoys.

Land and Joint Programmes

The new DPP has finally launched the long-awaited programme for the development of a new family of vehicles under the Armoured Infantry Combat System (AICS), centred on a combat (Armoured Infantry Fighting Vehicle – AIFV) and different support platforms based on the same chassis. To be modular and capable of evolution and growth potential to cope with present and future operational scenarios, the AICS is expected to be developed within the cooperation activities already existing between Italian and European industries, although no further details were released. The Italian MoD put aside an initial amount of €2.14Bn, to be followed by other funding tranches. In the meantime, the development phase for the modernisation of the ARIETE main battle tank programme continues to extend their service life until a replacement will begin to be delivered from 2035 onwards. The Italian MoD also launched the joint Army-Navy programme for a family of platforms based on a new amphibious protected wheeled vehicle (VBA, Veicolo Blindato Anfibio) to be provided by national industry to equip the joint national projection force from the sea with an initial budget of €326M, while the overall programme is expected to require €1.3Bn in funding.

The Italian Army's lightweight component will be enhanced with a programme to boost the expeditionary and power projection from the air. This will include the involvement of the Folgore paratroop brigade, as well as the continuation of the procurement for the LINCE 2 and medium multirole tactical vehicles in the command post version, in addition to new batches of the soldier individual combat and protection system (SIC, Sistema Individuale di Combattimento). A new short-range antitank and multi-purpose weapon system, alongside additional tranches of the SPIKE family of missiles is also included. A new longer range ammunition (ER, Extended Range) for the GMLRS (Ground Multiple Launch Rocket System) will be acquired together with a new 105 mm ultra-light and air-droppable towed howitzer (ULH), as well as the mass-production procurement for the Leonardo VULCANO longrange guided ammunitions together with upgrading activities to the PZH-2000 and the FH-70 artillery systems. In 2022, the Italian Army will also launch the procurement of new radar-based weapon location systems, while a multi-platform programme for unmanned aerial vehicles of different sizes fills a gap in the current inventory from 2021. The Carabinieri armed



Last December, the Italian MoD signed a contract with the CIO consortium consisting of Iveco Defence Vehicles and Oto Melara (today Leonardo) for the procurement of 86 CENTAURO II armoured wheeled vehicles.



The Italian MoD is continuing to enhance the capabilities of its mechanised and light units with the procurement of new batches of the FREC-CIA infantry fighting vehicle family, here depicted, in addition to LINCE 2 light multi-role vehicles and medium multi-role tactical vehicles in the command post version.

force has also launched a comprehensive programme for new tactical, protected and transport vehicle of different sizes and missions.

Among the joint armed forces programmes, in addition to the procurement of new batches of the Leonardo AW169 LUH (Light Utility Helicopter) for the Italian Army and Carabinieri, the Italian MoD also funded the launch of a new phase of studies from 2022 for the development of a new generation of multirole rotary-wing platforms. Known as Future Fast Rotorcraft initiative, it is aimed to develop a Next Generation Fast Helicopter, looking to synergies with international programmes. These multi-year funded activities are covered so far with €129M. The programme for development and procurement of the Leonardo AH-249 combat helicopter is continuing. In addition to the upgrading activities for the V-SHORAD (Very Short Range Air Defence) capabilities based on the STINGER missiles, as well as the new GRIFO SHORAD system based on the MBDA CAMM ER missile, the DPP 2021-2023 highlights the expansion of the scope of the SAMP/T NG programme for the Italian MoD. Last March, OCCAR awarded the contract to Eurosam for the upgrading of the Italian Army and French Air Force in-service batteries under the mentioned programme. In addition to the same activities and the ASTER missiles family service-life extension programme, the Italian MoD also highlighted the upgrading to a full operational standard of an additional sixth battery, which will be used for training purposes in support of the Italian Army and, in the future, the Italian Air Force. The overall funding request is worth €3.05Bn of which €2.37Bn is already allocated. A parallel procurement programme for the SAMP/T NG system radar provided by Leonardo is part of a wider project which also includes the acquisition of new generation radars for the Italian Navy to support the FSAF/PAMMS air defence missile systems which will also receive the ASTER 30 Block 1NT EC under development with the SAMP/T NG programme. The overall funding request is €800M of which €367.82M is already allocated.

Italy's Joint Programmes

Thanks to the overall funding made available with the abovementioned 'ordinary' and 'extra'-defence budget investments, the DPP Italian MoD's 2021-2023 budget plan is supporting the joint, secure and interoperable cloud-based information environment for defence, the digitisation process of its information communication systems (ICT) and networks, as well as the protection of the overall defence infrastructure against cyberattacks. The Italian MoD has also launched the programme for a network of defence innovation centres to work in synergy with the civilian research world, and is funding research and development programmes in the sector of emerging disruptive technologies. It is enhancing its multi datalink hardware and software network together with new-generation Identification Friend and Foe (NG IFF) equipment, with further funding mainly directed to unmanned vehicles counter-systems including direct energy weapons, medical developments related to COVID lessons and contribution to the European PESCO and EDIDP/EDF initiatives. A major push to the Italian MoD's overall strategy in the space communications domain came from the contract awarded last June to Thales Alenia Space and Telespazio for the SICRAL 3 satellite system and ground segment, while further funding is being provided for the enhancement of equipment and support of the Joint Special Forces Command and Armed Forces units.

Masthead

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Cover: Leonardo's 127/64 LW naval gun system is qualified to fire VULCANO long-range guided munitions. Photo: Leonardo Annual subscription rate: €82.50 incl. postage

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Naval Fire Support Evolves

Luca Peruzzi

Naval fire in support of littoral and deeper in-land operations is registering a significant shift towards longer range and higher speed weapon systems among major navies.

Confronting anti-access/area denial (A2/ AD) and advanced air defence systems operational scenarios, larger naval forces are working on higher speed anti-ship and deep strike weapon systems alongside unmanned platforms and autonomous or semi-autonomous weapon systems. Nevertheless, there are still requirements for more conventional solutions such as guided munitions and missiles together with affordable loitering weapon systems to cope with a wide range of missions, especially in more permissive scenarios and crisis situations and for naval forces which do not possess large budgets.

European Naval GLR

According to Leonardo, the VULCANO family of guided long-range (GLR) munitions in 127 mm and soon 76 mm calibres for naval applications is the only qualified and available munition of its kind on the market today. Developed and based on a joint Italian Army-Navy requirement for both 155 mm and 127 mm, and gualified in both calibres in 2019 under a joint Italian and German MoU, the VULCANO 127 GLR was developed according to STANAG 4667, and is based on the common (with different calibres) fin-stabilised sub-calibre airframe design. It has canard control for extended range without the need for a rocket motor or changes to the gun system, in addition to a high lethality pre-fragmented warhead, alongside mechanical interfaces that are the same as standard ammunition, allowing no change to the gun's rate of fire. Terminal guidance is assured by an IMU/GPS unit, a programmable multifunctional fuse (impact, delayed impact, height of burst, and time) and optionally infrared (IR) or SAL (Semi Active Laser) interchangeable and plug-and-play seekers developed and provided by German Diehl Defence. The first seeker is used to engage moving surface targets at sea, while the SAL is used to engage fixed/ moving targets with third party laser designation. The operational validation campaign by the Italian Navy was car-



Leonardo's 127/64 LW (LightWeight) naval gun system is fully qualified to fire VULCANO long-range guided munitions from the ship's command management system (CMS) with a fully automated ammunition handling system.

ried out with live at-sea firings from the Leonardo 127/54C and 127/64 LW (Light-Weight) guns in 2017-2018, making both guns the only in-service qualified to fire GLR munitions from the ships' command management system (CMS) with a fully automated ammunition handling system. The Italian Navy also qualified the VULCANO Ballistic Extended Range (BER) ammunition (without guidance kit) capable of reaching 60 km with the Leonardo 127/64 LW and potentially with the BAE Systems Mk45 gun, as no integration was so far conducted with the US system. The VULCANO ammunition in a specific 155 mm variant was successfully land-tested also with the BAE Systems AGS (Advanced Gun System) installed on the US Navy's ZUMWALT class destroyers. The VULCANO 127 GLR can reach up to 90 km with the 127/64 LW gun, providing an all-weather precision attack capability (<5 m CEP). According to the latest Defence Planning Multi-year (2021-2023) document, the Italian MoD has an ongoing VULCANO 127 GLR mass-production procurement and support programme with funding starting in 2021. In the meantime, the Italian group is developing and testing the VULCANO GLR munition for the 76/62 mm SUPER RAPIDO gun system under a contract awarded by the Italian Navy within the 76/62 SIN-GLE DECK gun mount development and qualification programme. The VULCANO 76 GLR, with a range up to 40 km, is planned to be available for production in the 2023-2024 period, further boosting the fire support capabilities of the SR gun on the international market, with the VULCANO 76 BER munition already qualified and in service with at least one South Asian customer. In addition to the Italian and the German Navies, the 127/64 LW VULCANO was also acquired by Algeria, The Netherlands, Spain and Canada, making them potential candidates also for the 127 GLR procurement. Egypt, which has already received two FREMM frigates equipped with the 127/64 LW



The Leonardo VULCANO family of long-range 127 mm munitions is qualified and available in both not-guided BER (Ballistic Extend Range) and guided GLR (Guided Long Range) versions.



The Leonardo 76 mm VULCANO family of long-range munitions is also qualified and available in the BER (Ballistic Extend Range) version and under development and qualification in the guided GLR (Guided Long Range) variant.

VULCANO and is the first international customer for the VULCANO 127 BER munition according to Italian export documentation, could potentially soon acquire the VULCANO 127 GLR. Different 76/62 SR operators are showing strong interest in the VULCANO 76 GLR, as both 76/127 mm Leonardo guns are delivered fitted-for the GLR ammunition.

US Naval GLR and HVP Developments

As anticipated, the development and entry into service in recent years of new long-range threats represented by hypersonic weapon systems and the need to develop new defensive and offensive capabilities pushed the US Navy to recapitalise resources on longer range and higher speed weapon systems. In 2016, the service decided to cancel the 155 mm Long Range Land Attack Projectile (LRLAP) to equip the BAE Systems AGS (Advanced Gun System) installed on the US Navy's ZUMWALT class destroyers which was cancelled in 2016 due to munition costs and the programme of record that decreased it to three ships, making it impossible to benefit from economies of scale. The efforts to find an alternative

to the LRLAP, were halted as the US Navy re-evaluated the missions for the ZUM-WALT class platforms and shifted the core mission of the ship from supporting ground forces close to the littorals to blue-waters, capable of striking other surface vessels. In April 2021, the US Navy Chief of Naval Operations announced that the ZUMWALT class destroyers will be the first hypersonic missile-equipped platforms at sea. In the meantime, the industry developed technologies and solutions to meet the US Navy requirements for Naval Surface Fire Support with 5-inch (127 mm) guns. Raytheon, together with the BAE Systems BOFORS, offered the already available 155 mm EXCALIBUR guided artillery round in production and service with the US Armed Forces and international artillery forces and developed a specific version known as EXCALIBUR



The 5-inch (127 mm) 62-calibre Mk 45 Mod 4 naval gun system is in service with the US Navy and worldwide operators and is to significantly enhance Naval Surface Fire Support (NSFS).



Designed to be fired from the Navy's 127 mm (5-inch) guns, EXCALIBUR N5 doubles the range of the Navy's big guns and delivers the same accuracy as the land-based version.

N5 for naval applications. Designed to be fired from the Navy's 127 mm (5-inch) guns, "the EXCALIBUR N5 doubles the range of the Navy's big guns and delivers the same accuracy as the land-based version", according to Raytheon. Together with the Navy, the US group conducted a series of land-based firing campaigns to demonstrate the N5's capabilities, which

Developed by BAE Systems, the HVP is described as a next-generation, common, low-drag, guided projectile capable to be fired from different gun systems, including the Navy 127 mm, and Navy, Marine Corps, and Army 155 mm systems.

Photo: Raytheor



Photo: BAE Systems

The Naval Strike Missile (NSM) is in service with the Norwegian armed forces and was procured by the German MoD, in addition to Malaysia, Poland, Romania, the and the US.



The RBS 15 Mk 4 is the latest generation of the Saab anti-ship missile to equip GRIPEN E multi-role fighters and VISBY class corvettes.

reuses the guidance and fusing components from the EXCALIBUR Block 1B. Both Lockheed Martin and Orbital ATK (today Northrop Grumman Innovation Systems) also offered solutions, the latter centred on the PGK (Precision Guidance Kit), while BAE Systems has been proposing the VULCANO GLR based on a partnership with Leonardo.

The abandonment of these activities means that the only potential solution is the Hyper Velocity Projectile (HVP), better known as Gun-Launched Guided Projectile (GLGP), developed by BAE Systems for the US Armed Forces and its allies. It is described as a next-generation, common, low-drag, guided projectile capable of executing multiple missions such as Naval Surface Fire, Cruise and Ballistic Missile Defence, Anti-Surface Warfare and other future missions for a number of gun systems, including the Navy's 5-inch (127 mm), Navy, Marine Corps, and Army 155 mm systems and future electro-magnetic railgun (EMRG). It is also capable of speeds of Mach 3 when fired from the 127 mm and 155 mm and accredited by BAE Systems with a range of more than 93, 130 and 80 km respectively from the Mk 45 Mod 4, AGS and 155 mm artillerv gun systems. Twenty HVPs were fired in summer 2018 from the DEWEY, an AR-LEIGH BURKE class destroyer as part of a series of testing conducted by the Navy and the Office of Secretary of Defense (OSD)/Strategic Capabilities Office (SCO) as a low-cost weapon against missile weapon systems and unmanned aerial vehicles. At the end of summer 2020, an HVP was fired from an AGS tube mounted on a M110 8-inch self-propelled artillery chassis during the Advanced Battle Management Systems (ABMS) Onramp 2 at White Sands Missile Range to successfully down a cruise missile surrogate target. However,, with its proposed Fiscal Year 2022 budget, "the DON (Department of the Navy) terminated the GLGP R&D. Potential reinvestment in the programme will be re-evaluated after an ongoing Strategic Capabilities Office demonstration effort in Terminal Defense Analysis is complete." In the meantime, last March, the OSD/SCO, with support from the US Army, awarded BAE Systems a US\$16M contract to mature and demonstrate the lethality of the HVP against ground targets at extremely long ranges. It will work with the SCO and the US Army to add capability, improve the existing HVP system and test the enhanced capability beginning this year through 2022. "The award will allow for continued technological advancements while supporting efforts to further reduce development, production, and total ownership costs", the company said.

Missiles and Long-Range Strike Weapon Systems

Deep strike and anti-ship missile systems represent the long arm of the currentgeneration of navies against both fixed and mobile high-value targets where the ship component is not supported by naval aviation with an aircraft carrier, fixed-wing and/or short take-off and vertical landing aircraft, which are also capable of carrying new generation airto-surface weapon systems such as the MBDA SPEAR 3. A range of older generation Western anti-ship missile systems, such as the Boeing HARPOON, MBDA EXOCET and OTOMAT/TESEO families and Saab's RBS 15 have been upgraded during the life cycle with a navigation suite including a GPS to give a land-attack capability on fixed targets, as well as more capable fuel tanks and efficient propulsion to extend their range. An enhanced land-attack capability against both fixed and mobile targets in highly contested environments comes from a deeper renovation or newer design with datalink and more advanced navigation and seeker systems. Although limited in scope and procurement, an example of specific land-attack capabilities comes from the UK's I-SSGW (Interim-Surface to Surface Guided Weapon) programme. This provides 'a ship launched over the horizon precision anti-ship capability and a terrain following precision maritime land attack capability' as an interim system replacement of the HAR-POON, waiting for the joint French-UK new Future Cruise/Anti-Ship Weapon (FC/ASW) system, which according to the UK MoD, will equip the Type 26 frigates from 2028 onwards. Among the potential candidates are the latest western anti-ship missiles including the Naval Strike Missile (NSM), the RBS15 GUNG-NIR Mk4, the GABRIEL V/SEA SERPENT and the LRASM (Lockheed Martin Long Range Anti-Ship Missile). Last July, the Norwegian and German procurement agencies awarded a contract to Kongsberg Defence & Aerospace for the replenishment and updating of the inventory stock of Naval Strike Missiles (NSM) for the Norwegian MoD. With the procurement of the same missiles, the German Navy becomes the 6th cus-



The first batch of Block V TOMAHAWK cruise missiles was delivered by Raytheon to the US Navy in March 2021. The latest version for surface and underwater platform applications will come in both a deep strike and anti-ship versions.

tomer to select the NSM, in addition to Norway, Malaysia, Poland, Romania and the US. The low-observable compositemade missile, able to operate in both blue waters and littoral environments, is equipped - differently from most competitors - with an advanced passive guidance package which combines GPS-aided navigation with laser altimeter and a dual-band imaging seeker with autonomous target recognition and selectable aim point for terminal guidance. A joint development by Germany and Norway of a future NSM is planned according to the German MoD. The RBS15 Mk4 is the latest generation of the Saab antiship missile, which was awarded the development and procurement contract by the Swedish MoD in 2017 to equip GRIPEN E multi-role fighters and VISBY class corvettes. Characterised by a lighter composite airframe, the re-architec-



The TESEO Mk2/E weapon system under development by MBDA will be equipped with an advanced radio frequency and Semi-Active Laser (SAL) seekers.

tured development of the existing Mk3 version will be equipped with an advanced navigation and guidance system capable of operating on both sea and land and an RF seeker with enhanced processing and all-weather capabilities. The current Mk 3 version is under delivery or in service with Sweden, Germany, Poland and Algeria. Last April, Israel Aerospace Industries (IAI) announced a joint proposal with Thales UK of the SEA SERPENT missile for the UK I-SSGW programme. The SEA SERPENT, whose details are limited, is based on the latest GABRIEL V variant, also known as the Advanced Naval Attack Missile (ANAM), which is in service with the Israeli Navy and has been procured by the Finnish MoD. Lockheed Martin developed and tested a shipborne version of its AGM-158C LRASM, which was selected by the US DoD for the air-launched Offensive Anti-Surface Weapon (OASuW) Increment 1 programme to equip both the F/A-18 E/F and USAF's B-1. Launchable from MK41 VLS and deck-mounted angled launchers, it is armed with a 453kg penetrator and blast-fragmentation warhead. The LRASM also employs a weapons data link, an anti-jam GPS, and a multimode passive seeker suite with autonomous target recognition. MBDA is working on the TESEO Mk2/E weapon system, which was awarded a development, qualification and industrialisation contract in November 2020 by the Italian MoD. MBDA Italia has conceived a completely new long-range missile weapon system for the Italian Navy. This is centred on a transonic (less than 5-m-long and 700 kg heavy airframe, not including the booster and single-shot canister for ship-launched operations) with significantly reduced radar cross section and efficient propulsion package providing an effective range in excess of 350 km at sea-skimming level. In addition to a state-of-the art scalable warhead and advanced 4D mission planning systems, alongside a fully autonomous integrated INS/GPS suite supported by an adaptive radar altimeter and a two-way satellite data link, the TESEO Mk2/E will be equipped with a new coherent RF seeker and semi-active laser (SAL) channel for highly precise engagement with third party support. The contract also includes an ongoing feasibility study to

Innovation

SEEING A

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introduce an alternative next-generation Active Electronically Scanned Arraybased seeker, funding permitting, representing a game changer capability offered by MBDA together with Leonardo. The deep-strike Raytheon TOMAHAWK cruise missile is subject to a life recertification programme to ensure a 30-year service-life in support of US and UK inventories. The first batch were delivered last March. Upgrade activities will enable the system to operate with greater impunity in a jamming or anti-access/ area denial (A2/AD) environment, collectively known as Block V. These in-

Technology

clude navigation and communications modernisation, a new anti-jam GPS (M-CODE), a new warhead combining new penetration with current blast and fragmentation capabilities (Joint Multiple Effects Warhead System) and the introduction a new multi-mode RF seeker (MST, Maritime Strike TOMAHAWK) for anti-surface operations on an undisclosed number of missiles. Centred on an advanced Integrated Single Box Solution (ISBS) radio with two new satellite antennas (covering UHF and another band), the communications upgrade enables missile launch via a fine align-

ment solution and navigation using TERCOM/DSMAC/Vertical Update Point in a GPS denied/ degraded environment, according to US Navy documentation, with release to the fleet due in 2021. Launched for the first time on October 2020 from the SUFFREN class nuclear attack submarine to provide the French Navy a deep strike underwater capability with a European-made cruise missile in addition to equipping surface platforms, the Missile de Croisière Naval (MdCN) shares the guidance system with the SCALP-EG/ Storm Shadow air-launched stand-off cruise missile. The latter combines INS, GPS and terrain profile matching with an imaging infrared (IR) seeker with automatic target recognition (ATR) capabilities, to achieve metric accuracies in the terminal phase.

Early last September, the US OSD/SCO and US Navy revealed a live firing test video of a Raytheon SM-6 (RIM-174) weapon system with anti-air/anti-surface capabilities from a modular launcher embarked on an experimental unmanned surface vessel (USV) of the Ghost Fleet Overlord programme. This is the latest known live firing of the SM-6, which was successfully launched last April from an ARLEIGH BURKE class destroyer against a small drone boat with a complex kill chain using passive sensors. The SM-6 is an extended-range active missile designed for network-enabled operations using third-party targeting. The missile can be used in anti-air, sea-based ter-



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The MBDA Missile de Croisière Naval (MdCN) was launched from the SUFFREN class nuclear attack submarine for the first time in October 2020.



The SEA BREAKER is described by Rafael as a 5th generation marine and land-launched weapon system capable to reach distances up to 300 km for accurate strike against sea and land targets.

minal defence and anti-surface roles and was also selected by the US Army to satisfy its ground-based Mid-Range capability (MRC) as part of the larger Long-Range Precision Fires initiative.

New Solutions

Both industry and navies are working on innovative solutions to deliver an affordable capability for striking, in addition to providing intelligence against littoral and deeper land-based targets. Rafael Advanced Defense Systems has recently unveiled testing of the SEA BREAKER, "a 5th generation marine and landlaunched weapon system capable to reach distances up to 300 km for accurate strike with pin-point hitting of a vast variety of high-value sea and land targets" according to the company. With a 4- metre long airframe with foldable wings and turbojet propulsion weighing less than 400 kg without booster, the new munition is launched by multiple canisters which can be fitted to fast attack missile boats from 100 tonnes. The SEA BREAKER, according to Rafael, is equipped with an advanced IIR (Imaging Infra-Red) seeker with Automatic Target Acquisition (ATA) and Automatic Target Recognition (ATR), which, thanks to artificial intelligence, allows it to perform deep-learning and big-data based scene-matching, providing fully autonomous mission and target engagement. The missile is equipped with a datalink which supports real-time man-in-theloop decision making and tactical updates and an advanced mission planning and control system.

The US Department of the Navy, in addition to the GLGP, with its proposed Fiscal Year 2022 budget request, also terminated the EMRG (Electromagnetic Rail Gun) activities, putting an end to an R&D activity started in 2005 to provide naval fire support to troops ashore. In Europe last April, the European Defence Agency (EDA) assigned the leadership role to the Franco-German Institut Franco-Allemand de Recherches de Saint Louis of the 24-month "Projectile for Increased Long-range Effects Using Electromagnetic Railgun" (PILUM) programme. The latter is a feasibility study on the use of the electromagnetic railgun (EMRG) as a long-range artillery system. The project will further examine the possibility of integrating the EMRG into land and naval platforms.

Missile weapon systems derived from land-application programmes such as the Rafael NAVAL SPIKE NLOS (Non-Line-of-Sight) with a 32 km range are already operational with naval forces worldwide. However, the extensive use of loitering strike weapon systems during the 2020 Nagorno-Karabakh conflict between Azerbaijan and Armenia, significantly influenced the future plans of not only land-operations forces, but also navies and amphibious forces worldwide. Last January, the USMC System Command awarded the US Mistral company a contract to design, develop, build and test the Organic Precision Fires - Mounted (OPF-M) munition system and integrate the it onto the LAV-M and JLTV land tactical vehicles and the future LRUSV (Long-Range Unmanned Surface Vehicle). The US company teamed with Israeli company UVision to deliver the USMC with a loitering strike munition capability based on UVision's HERO 120. Weighing 12.5 kg and launched by canister, it carries a 4.5 kg warhead and has a 60-minute flight endurance to provide both ISR (Intelligence Surveillance and Reconnaissance). It has highly accurate and precision indirect fire strike capabilities, but the company also offers the HERO-400EC for naval applications weighing 40 kg, with a 10 kg warhead, a 150 km (LOS) range and 120- minute flight endurance.



In January 2021, the USMC awarded a contract to Mistral company, together with UVision, to develop and integrate the HERO 120 loitering munition onto the LAV-M and JLTV tactical vehicles and the future LRUSV (Long-Range Unmanned Surface Vehicle).

Personal Power Supplies

Tim Guest

The individual soldier of the future will wear and carry more technology than ever before, as the various future soldier programmes in play around the globe prove. And with many worn sensors and powered equipment involved, the need for effective, personal power supplies is fundamental.

The connected soldier on the networked battlefield is power hungry. This article looks at what is driving the need for reliable and evermore efficient batteries and personal power supplies on today's battlefield.

More Tech, More Power

From GPS and smartphones, to personal radios, tablets, night-vision goggles (NVGs), infra-red weapon sights and other optical systems such as video cameras; these are just some of the devices and equipment the dismounted soldier is expected to carry/wear today, all of which place high and low-power demands on personal power supplies carried by the individual soldier. High power for such things as laser range finders, low power for such as NVGs. And having become a major source of intel and situational data gathered by those various sensors, which will ideally be uploaded to higher formations for informed tactical and strategic decision-making purposes, it makes it even more essential the power needs of all those sensors and systems are met and managed. And management is crucial; important energy savings can be made by power management systems intelligently delivering only the right amount of energy required, when it's required, to a device, interrupting supply completely until it's needed again, as well as monitoring charge state, so no soldier runs out of power for a life-critical application at the wrong moment.

Powering One Future System

For the French FELIN system, one of the future soldier programmes alluded to above, this consists of several powered systems including latest optronic devices fitted to

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FELIN is designed to have all its sub-systems powered by two rechargeable Li-ion batteries and peripheral equipment can be connected to the physical connection ports situated at the front of the battery units.

the individual soldier's personal weapons, the FAMAS assault rifle and the MINIMI light machine-gun and FRF2 sniper rifle. These devices include light intensification/thermal imaging sights and for the FAMAS rifle the sight also incorporates a video camera to transmit images to a video monitor on the soldier's chest or to his helmet's ocular display. The soldier's helmet is also fitted with optronic systems, including a helmet-mounted thermal imager and these will display their output on the same miniature displays as the images from the weapon-mounted video camera. The system's electronic jacket integrates electronics such as computer unit, manager unit, radio, man-machine interface, GPS, cables and connector. FE-LIN's personal communications systems enable individuals to establish a local combat network at the infantry section level. Platoon commanders are additionally equipped with a multi-function compass/ range finder/thermal imaging monocular sight providing an additional observation capability, day or night, and section commanders and special-purpose groups, e.g. recon patrols, are further equipped with a portable information terminal to enable encrypted communications with commanders for the relay of tactical and situational intel. And all these systems require power, and that means carrying batteries, which add weight. For FELIN, at its heart is a portable electronic platform designed around a high-volume databus (USB 2.0), that manages the power resources and signal exchanges between the various sub-systems. By ensuring that components have maximum interoperability, FELIN has been able to cut weight and ensure that soldiers don't need to carry any more batteries than necessary. Indeed, FELIN is designed to have all its sub-systems powered by two rechargeable Li-ion batteries and peripheral equipment can be connected to the physical connection ports situated at the front of the battery units. The Li-ion batteries are provided, in part, by official Felin project developer and supplier, the Swiss Leclanché group and French military vehicles are equipped for infantry to recharge those batteries; collective recharging units using aluminium-air/metal-air fuel cells are also used for recharging.

Juice for Buck

In general, and relevant to any military procurement personal power supplies whether for future soldier systems like FE-LIN, or other applications, when assessing battery weight, users need the greatest watt hours per kilogramme (Wh/kg) that's affordable to them. Armed forces are continually having to manage the continued use of legacy equipment and technologies, even as new systems enter service to run alongside older tech. In the case of batteries, some of the devices and sensors used by the individual soldier will often be able to share the same battery, although many systems will not, hence soldiers end up having to carry several kinds. Each device a soldier carries might have been added to the kit at a different time and require a battery that is not compatible with the rest of it. For example, a new piece of equipment added to the rifle might need its own battery, which could mean modifying the weapon, or running a cable from the rifle to a battery carried by the soldier. This could be a multi-purpose battery such as the BB-2590, design over 40 years ago to power manpack radios, though today has more than 50 different uses. Indeed, the BB-2590/U family is now the most widely used military battery in the world. Operated by US and NATO forces in numerous tactical applications, BB-2590/U type batteries provide personal power supplies to power such things as communications equipment, sensors, surveillance equipment, thermal imagers and robotic systems. The rechargeable battery chemistry in the BB-2590 has evolved from its original lead-acid configuration, through nickel-based to its current lithium-ion (Liion) chemistry with product supplied by leading industry battery makers such as Bren-tronics, Epsilor, Saft and many others.

Taking Saft as an example, in its efforts to lighten the soldier's load, the company's most recent version of the BB-2590 -- the BB-2590HC/U -- offers 187 Wh/kg, compared with its predecessor's 127 Wh/kg performance. Saft's military Li-ion battery packs today include safety features such as electronic protection, thermal fuses, positive temperature coefficient fuses and diodes, with some versions also including an LED or LCD fuel-gauge display; all are compatible with various constant current/constant voltage chargers. State-of-Charge/Stateof-Health indicators are also increasingly included on a range of Saft and other makers' batteries as an additional way to help the individual soldier monitor the charge levels of their personal power supplies.



US Army-funded research by the University of Michigan demonstrates a new approach to turning thermal energy into electricity that could provide compact and efficient power for soldiers on the battlefield.

A Personal Powered Future

The soldier of yesteryear had few personal power needs for which basic batteries have long been the traditional source of dumb, unmanaged power. If more power was needed, spare batteries were carried, but a pouch full of batteries means one less full of ammunition. Today's future soldier systems, however, with all their high-tech sensors and powered gadgetry, demand innovative ways to power everything, without weighing down an already weighed-down soldier with masses of spare batteries. Much R&D has been undertaken into personal power solutions that reduce the logistical load and enable the individual to remain as mobile and agile as possible; from smaller, lighter batteries using latest chemical solutions such as Li-ion tech, to renewable sources such as worn, flexible, solar panels and innovative power-generating technologies. Even isotope batteries are currently being researched to power the individual soldier; the feasibility of accessing energy stored by isotopes at some 100,000 times the density chemicals can provide is being investigated by the US Army and, if successful, will break through the constraints of chemical-based battery solutions.

A further innovative approach to generating personal power is that of turning thermal energy into electricity; the surfaces of hot objects radiate light in the form of photons into their surroundings and these photons can then be captured by a photovoltaic (PV) cell and converted to useful electric energy in a conversion process called far-field thermophotovoltaics, (FF-TPVs). Under development for several years, this process is hindered by its low power density and requires high operating temperatures of the hot surface/emitter. A new take on this, however, demonstrates how, when the separation between the emitter and the PV cell is reduced to the nanoscale, it enables much greater power output than is possible with FF-TPVs at the same emitter temperature; this capturing of energy, that is otherwise trapped in the near-field of the emitter, is called near-field thermophotovoltaics (NF-TPV). The US Army's Research Laboratory has said that if successful, near-field-TPVs could serve as more compact and higher efficiency power sources for soldiers in the future, as these devices can function at lower operating temperatures than conventional TPVs.



French infantryman with FELIN 2 night vision goggles

Softkill Solutions for the Modern Navy

Doug Richardson

Comprehensive electronic-warfare (EW) suites have long been a feature of most surface warships, but the brief survey that follows will focus on the equipment fitted to the latest ships from a selection of the world's major navies. Although some modern warships are being fitted with sensors able to detect incoming laser energy, and in some instances with anti-laser countermeasures, the text will focus on radio-frequency (RF) hardware.

The primary electronic warfare system on US Navy ships is the Raytheon AN/ SLQ-32. First fielded in the late 1970s, and probably the most widely-deployed naval EW system, this has seen service in seven basic variants. Early versions were passive and had no jamming capability. The (V)1 was designed to receive high-band radar signals typically transmitted by aircraft and missiles and was fitted to auxiliary ships and frigates, while the (V)2 installed on some frigates and on destroyers could also detect enemy surveillance and targeting radars.

SLQ-32(V)3 was the first variant to add an active radar-jamming capability, and was installed on cruisers, battleships, large amphibious ships, and high-value replenishment vessels. Aircraft carriers were fitted with the SLQ-32(V)4, which consisted of two (V)3 systems (one on each side of the ship), and a common computer and display console. The EXOCET attack on the OLIVER HAZARD PERRY class frigate STARK in 1987 triggered the development of the SLQ-32(V)5, a more compact version of the (V)3 system that provides this class of warship with an active-jamming capability.

Since the SLQ-32 had been designed in modular form, upgrades were easy to implement and were often conducted when a ship underwent major overhaul. So (V)1 systems were often modified to the (V)2 standard, and (V)2 versions could become (V)3. SLQ-32 was to have been replaced by the AN/SLY-2 Advanced Integrated Electronic Warfare System (AIEWS), but this

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The frigate USS STARK was hit by two Iraqi EXOCET missile on 17 May 1987. Although the ship's Super Rapid Blooming Offboard Chaff (SBROC) launchers were armed, they were not used. Following the missile impacts, the ship's captain ordered that the starboard side be deliberately flooded in order to keep the hole on the hull's port side above water.

programme was cancelled in 2002 due to over-runs in time and cost. It was replaced by the Surface Electronic Warfare Improvement Programme (SEWIP), which uses an open architecture in order to allow rapid integration of emerging technologies.

Block I (which is sub-divided into Blocks 1A, 1B1, 1B2, and 1B3) is intended to improve anti-ship missile defence, counter-targeting and counter-surveillance capabilities, as well as tackling hardware-obsolescence issues. It also adds Specific Emitter ID (SEI) and High Gain/High Sensitivity (HGHS) capabilities intended to provide improved situational awareness. HGHS is intended to provide better capability against lowprobability-of-intercept signals.

SEWIP Block 2 includes an upgraded antenna, a new digital receiver, and enhanced processing capabilities. The combination of Block 1B3 and Block 2 hardware creates the SLQ-32(V)6 standard, which entered service in 2014 on the DDG 51 Flight IIA destroyer BAINBRIDGE (DDG 96). It is now in service on a growing number of DDG-51 guided-missile destroyers, also on DDG-1000 destroyers and on large-deck amphibious ships. The planned CONSTELLATION class frigates will have two SLQ-32(V)6 Surface Electronic Warfare Improvement Programme (SEWIP) Block 2 systems.

A compact SLQ-32(V)6C variant – also known as SEWIP Lite – was developed for use on the Littoral Combat Ship (LCS), but its first application was the US Coast Guard's Offshore Patrol CUTTER.

SEWIP Block 3 provides improved Electronic Attack (EA) capability intended to keep pace with the evolving threat. A combination of the Block 1b, Block 2, and Block 3 will make up the SLQ-32(V)7 standard, which is earmarked for use on

DDG-51 destroyers, NIMITZ and FORD class aircraft carriers, and WASP class amphibious assault ships.

No other navy can match the sheer scale of the SLQ-32/SEWIP programme, but many are trying to standardise the EW suites deployed aboard shrinking numbers of ships. The UK Royal Navy's Type 45 DARING class destroyers are equipped with the Thales VIGILE-D wideband digital Electronic Support Measure (ESM) system as part of the UAT Mod 2.0 and 2.1 programmes. There is a follow-on UAT Mod 2.3 programme, and VIGILE-D will be introduced to the rest of the UK's surface fleet. It has also been ordered by several other navies in NATO and the Middle East. The Type 45 is also equipped with the SHAMAN communications electronic support measures (CESM) system, a variant of the AN/SSQ-130(V) increment F which entered USN service in 2016

France's FORBIN class (HORIZON) destroyers are fitted with a SIGEN consortium (Thales/Electronica) EW suite comprising radar warning equipment, a high-power jammer, and an ESM/ECM support aid, while a Thales ALTESSE-X provides comint (CESM). Two EADS NGDS 12-barrelled multifunction decoy launchers are also carried. SIGEN also provides the EW suite for the AQUITAINE class destroyers, which are also fitted with two EADS NGDS decoy launchers

The EW installation for the French Navy's planned class of five FDI (Defense and Intervention Frigate) warships has not yet been fully defined. AMIRAL RONARC'H - the first of the new class - is due to be delivered by the end of 2023, and the final example by the end of the decade. Potential components for the EW suite include the Thales' SENTINEL ESM and EW system and ALTESSE-H comint system, plus un-



Thales VIGILE-D digitises RF signals at the ship's masthead. The system is designed to cope with the ever-increasing complexity and density of electronic emitters in today's maritime environment.



The small rectangular antenna seen on the right-hand side of this photograph on the destroyer USS BAINBRIDGE is part of the vessel's SEWIP installation.

specified launchers for chaff, flares, and corner-reflector decovs.

Italy's ANDREA DORIA class destroyers are reported to be fitted with a MM/SLQ-750 system with electronic support measures (ESM) and electronic countermeasures (ECM) capability, plus two Otobreda SCLAR-H 20-barrel trainable chaff/IR flare launchers, while the BERGAMINI class multimission frigates combine the MM/SMQ-765 with the Thales ALTESSE-X, the Elettronica NET-TUNO 4100 modular H-J band jamming system, and two countermeasures launchers. On the first six ships, these will be Leonardo SCLAR-H, but the OTO Launching Decoy System 20 (OLDS 20) has been selected for the remaining four.

ADMIRAL GORSHKOV, the lead ship of the new class of guided missile frigates for the Russian Navy, was laid down in February 2006, but construction and fitting out were protracted, and the vessel was not launched until 2010. It did not enter service until July 2018. Two are now in service, and a third is due to be commissioned by the end of 2021. These are equipped with the KRET TK-28E/5P-28 ESM system, the PROSVET-M countermeasures launcher, and a CT-308 launcher able to release corner reflectors. The performance of the TK-28E/5P-28 is thought to be similar to that of the TK-25E, a version intended for smaller ships such as offshore patrol vessels. The latter system can detect emissions between 500 MHz and 40 GHz, analysing up to 100 signals simultaneously, and is able to jam two threats simultaneously. In 2020, Russia's TASS news agency reported that the two GORSHKOV class ships currently in service would be retrofitted with upgraded radars and modernised EW systems, but gave no details.

Delays with production of GORSHKOV class led to the decision to build the AD-MIRAL GRIGOROVICH class frigates. Their EW suite is reported to include the TK-25-5 ESM system and four KT-216 decoy launchers. A total of six frigates are



Russia's TK-25E shipborne electronic countermeasures system is designed to intercept and jam RF emissions from target-acquisition radars, fire-control radars, and anti-ship missile seekers.



Thales' ALTESSE-H is a shipboard system able to handle the CESM (Communications ESM) and COMINT (Communications Intelligence) tasks, monitoring and automatically identifying complex transmissions, including those from LPI burst and fast frequency hopping emitters.

planned, but only three are in service. Two of those currently fitting out have been assigned to the Indian Navy, and the third may share their fate.

Conceived as a cheap alternative to the ADMIRAL GRIGOROVICH class frigates, Russia's Project 22800 (KARAKURT class) missile corvette was announced in 2015. The first-of-class was launched in July 2017, and accepted into service in December 2018. Rosoboronexport is promoting



TCI COMINT system with Model 641N direction-finding antenna mounted at the top of the mast of an offshore patrol vessel.

the new class, but has released no information on its EW systems. Antennas for these are presumably contained in the ship's integrated mast.

Information regarding the EW fit of Chinese warships is somewhat sketchy. LUY-ANG I (Type 0528) destroyers team a SRW 210A ESM system designed for use aboard large and medium-sized warships with TYPE 984 AND TYPE 985 jammers covering I-band and E/F band respectively, and four 18-tube launchers for 100 mm decoys, but the follow-on LUYANG II (Type 052c) and LUYANG III (Type 052d) destroyers are fitted with the NRJ-6A, one of a family of modular systems offering threat-warning and jamming. JIANGWEI II-class (Type 053H3) frigates use the SR-210 ESM system, TYPE 981-3 noise jammer, and RWD-8 deception jammer, plus two chaff launchers.

Whether used to deploy chaff or other types of decoy, launch systems continue to play a major role. On USN ships, the SLQ-32 can be used to control the BAE Systems Mk 36 SRBOC Chaff and Decoy Launching System. This is a deck-mounted, 6-barreled mortar system able to launch chaff and infrared countermeasures intended to lure hostile missiles away from ships under attack. The number and arrangement of these launchers depends on the size of the ship, and can range from two launchers on a small combatant to as many as ten on an aircraft carrier. More than 1,000 systems are in service with the USN and with at least 19 other navies worldwide.

In April 2021, Rheinmetall announced the delivery of the 300th Multi Ammunition Softkill System (MASS). The customer was the Finnish Navy, which was also the system's first customer. Close to two decades after product launch, MASS is now in ser-

vice with 14 navies. A typical installation consists of between one and six trainable launchers.

The most recent variants are the MASS OCR with off-board corner reflector and a the new MASS ISS standalone version with an integrated sensor suite for use on ships that lack an independent capability for detecting laser and radar threats. MASS OCR uses launchers armed with two off-board corner-reflector rockets that produce ship-like radar signatures at locations between 35 and 850 m of the ship, and maintain their decoy effectiveness for more than 60 seconds. MASS ISS includes the REKa-50 subsystem able to detect threats operating in the millimetrewave frequency range.

Lacroix' New Generation Dagaie System (NGDS) is a two-axis trainable DLS system used by the French Navy and in what the company describes as "in a major foreign navy". In late 2020 Lacroix and Leonardo agreed to integrate Leonardo's MJTE (Mobile Jammer Target Emulator) into the SYLENA Mk2 launcher for small and medium-sized ships in order to protect these against subsurface threats.

It is questionable whether chaff and IR decoys will be able to counter the most sophisticated radar seekers fitted to some modern antiship missiles, so several companies have developed or are developing self-propelled decoys able to move away from the ship that has released them, and maintain whatever position or trajectory might be needed to maximise their effectiveness.

Developed by Australia and the US, the NULKA decoy is powered by a solid-propellant rocket. It is designed to hover and to move away from the ship that launched it, maintaining a pre-programmed height and speed. Its payload is a broad-band RF repeater able to radiate a large radarcross-section signal while the NULKA flying a trajectory that mimics the likely behaviour of a warship, thus presenting an attractive target to incoming missiles. In 2015, the carrier USS DWIGHT D EISEN-

HOWER successfully completed launch trials for the NULKA. Over a three-day period, the carrier used its MK 53 decoy launching system (DLS) to launch the NUL-KA decoy five times.

NULKA had its combat debut on 9 October 2016, when the guided-missile destroyer USS MASON and two other US warships were faced with two antiship missiles fired from the Yemeni coast by Houthi rebels. Mason fired two Standard Missile-2 (SM-2) and one Evolved SEA-SPARROW Missile (ESSM) against these threats, but also launched a NULKA. The
US Navy's planned CONSTELLATION class frigates will have four Mk NULKA decoy launching systems.

A custom-designed NULKA munition adapter allows the munition to be quickly and cost-effectively inserted into an Extensible Launching System (ExLS) designed to fit inside a cell of the MK 41 or MK 57 Vertical launch System (VLS), but Lockheed Martin had developed an ExLS standalone variant suitable for use on surface ships that are not equipped with a VLS. Developed in only 10 months, it was tested at the Royal Australian Air Force's Woomera Test Range in South Australia, were it successfully launched two NULKA decoys.

In 2019, the US Office of Naval Research awarded concept-design contracts to BAE Systems and Raytheon under the Long Endurance AOEW (Advanced Offboard Electronic Warfare) Platform programme covering initial work on a proposed longendurance softkill countermeasure against anti-ship missiles. Goal of this programme is to develop an expendable flight vehicle and an active-decoy payload that could enter service before the end of the decade. The payload is expected to weigh less than 10 kg, and be able to maintain twoway communications with the vessel it is protecting.

In 2020, Lacroix announced its Véhicule Ejecté Support Tactique d'Autoprotection (VESTA), a rotary-wing Uninhabited Air Vehicle (UAV) to be launched from a ship's countermeasures dispenser by a rocket booster. Likely to be of six-rotor configuration, this will loiter at a distance from the ship, and transmit a jamming waveform. VESTA is a long-term project and is not expected to deliver operational hardware until around 2030.

A different approach to creating a longduration offboard decoy is illustrated by the Royal Canadian NAVY'S Naval Off-Board Anti-Missile Active Decoy (NOMAD) programme. This is based on a Meggitt HAMMERHEAD unmanned surface vehicle (USV) carrying a jamming payload developed by Elbit Systems. Normally used as a target, HAMMERHEAD has an endurance of around 24 hours when travelling at speeds of 20 knots. Tests intended to validate the NOMAD concept are due to begin this year.

In mid-2019, the UK Ministry of Defence issued a Request for Information on EW technologies that could meet future Royal Navy requirements for softkill anti-missile defence. It expressed interest in off-the-shelf trainable decoy launchers, and expendable carriers or recoverable UAVs able to carry EW payloads.



Launch of an Elbit Systems DESEAVER MK-4 decoy. Fixed, rotating or stabilised launchers can dispense chaff or flare payloads able to operate in distraction, seduction, or confusion modes.



The destroyer USS RAMAGE launches a MK-59 decoy. Made by Irvin Aerospace and marketed as the IDS300, this inflates after release, and floats on the sea surface.



Lacroix's proposed VESTA rotary-wing decoy could form part of the French Navy's second-layer of defence against antiship missiles.

Slovak IFV Procurement Programmes

Martin Smisek

After many years of neglect, the Armed Forces of the Slovak Republic finally have a chance to obtain modern armoured fighting vehicles. In two procurement programmes, the Ministry of Defence plans to purchase 228 tracked and 500 wheeled armoured vehicles in different combat and combat support variants.

S ince 1993, when the Armed Forces of the Slovak Republic (Ozbrojené sily Slovenskej republiky, OS SR) were established, the backbone of their mechanised infantry units has consisted not only of the BVP-2 infantry fighting vehicles, but also of the older BVP-1s. Today, these vehicles are still operated by the 11th, 12th, and 13th Mechanised Battalion within the 1st Mechanised Brigade, as well as by the 21st and 22nd Mechanised Battalion attached to the 2nd Mechanised Brigade.

The unfavourable situation in the fleet of Slovak tracked armoured fighting vehicles was only partially and provisionally rectified in recent years with the introduction of 17 BVP-M infantry fighting vehicles and 18 BPsVI armoured reconnaissance vehicles. Both types were created by rebuilding the BPzV Svatava armoured reconnaissance vehicle, which was the last variant of the BVP-1 infantry fighting vehicle produced in Czechoslovakia between 1988 and 1990. Hence, despite their age, they were among the newest tracked armoured vehicles in the armament of the OS SR.

The main difference between the BVP-M and BPsVI vehicles lies in the ISTAR (Intelligence, Surveillance, Target Acquisition, Reconnaissance) equipment carried by the latter and in the variant of the TURRA 30 unmanned weapon station, which has a COAPS commander panoramic sight manufactured by Elbit Systems on the BVP-M vehicle. The Slovak companies KONŠTRUKTA - Defence, EVPÚ and MSM LAND SYSTEMS participated in the production and assembly of upgraded vehicles which took place between 2016 and

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The ASCOD 42 offered by GDELS at the VTSÚ testing range

2019. While the BVP-Ms were introduced into the inventory of the 13th Mechanised Battalion, the BPsVIs serve with the ISTAR Battalion of the 2nd Mechanised Brigade. The former unit fulfills the duties within the NATO Readiness Initiative.

Unsuccessful Procurement

The top priority of the Land Forces of the OS SR is the establishment of a heavy mechanised brigade according to the NATO Capability Targets 2017. The formation will be based on the current 1st Mechanised Brigade with three mechanised infantry battalions that will be complemented by a tank battalion, an ISTAR battalion, a self-propelled artillery battalion, a radiation, chemical and biological defence battalion, a command support battalion, a combat service support battalion, a logistic battalion, an engineer battalion, a ROLE2E field hospital, a CIMIC/PSYOPS centre and a military police company.

Despite the importance of this commitment, not much has been done in the area of acquisition of the main type of armament for the brigade - the new tracked infantry fighting vehicle. Instead, at its meeting on 15 November 2017, the Slovak Government approved the purchase of 8x8 (81 units of BOV 8x8) and 4x4 (404 vehicles BOV/VTV 4x4) wheeled armoured vehicles for the OS SR. The former materialised in the form of the VYDRA infantry fighting vehicle which was a combination of the Finnish AMV XP 8x8 SK chassis with the Slovak TURRA 30 remote-controlled weapon station. According to the plans at the time, the BOV 8x8 vehicles were to be used to arm three medium mechanised battalions. However, from the outset, the BOV 8x8 project faced harsh criticism from the political opposition and security analysts who blamed it for several shortcomings, including minimal transparency in the chosen method of acquisition. On the other hand, the Min-



The first contender presented within the Slovak tracked IFV programme was the LYNX KF41. The demonstration at the Záhorie testing range in March 2021 included, among others, live firing from the main gun.

istry of Defence of the Slovak Republic had consistently rejected these allegations and insisted that the vehicle meets all the requirements of the OS SR. In November 2018, the sole VYDRA prototype was bought by the Ministry of Defence for €4.3M. This step was to be followed by a decision of the Slovak Government to commence serial production. However, the then Government did not make such a decision and the new leadership of the Ministry of Defence formed after the elections in February 2020 canceled the project.

Compared to the BOV 8x8 project, the BOV/VTV 4x4 vehicles were due to be purchased in the frame of an international public tender. The Military Technical and Testing Institute Záhorie (Vojenský technický a skúšobný ústav Záhorie, VTSÚ) evaluated armoured vehicles of potential candidates to verify their technical specifications. Thus, during 2017 and 2018, the VTSÚ performed trials of the following types at the testing range at Záhorie: COBRA II, EAGLE IV, EJDER YAL-CIN, PATRIOT I, DINGO 2, AJBAN 440A, ALIGATOR MASTER II, SHERPA Light, GERLACH and PERUN 4x4.

According to the original plan, out of a total of 404 units, the Ministry of Defence planned to procure 327 VTV 4x4 multipurpose tactical vehicles with Level 2 ballistic protection and 77 BOV 4x4 combat armoured vehicles with Level 3 ballistic protection according to STANAG 4569.



Representatives of Rheinmetall Landsysteme GmbH and top officials from the Slovak Ministry of Defence (including Minister Jaroslav Nad' in the black face mask) watching the results of fire from the KF41's main gun.

Both types were to meet Level 2a/2b mine protection according to STANAG 4569. Their transport capacity was set to be four to six soldiers. The basic armament was to feature a .50 Browning or 7.62×51 mm machine gun in a mechanical turret or remote-controlled weapon station, an automatic grenade launcher or a launcher for four anti-tank guided missiles.

The tender in a slightly modified form was finally announced in June 2019. The Ministry of Defence requested the delivery of up to 424 VTV 4x4 vehicles with Level 3 ballistic protection and Level 2a/2b mine protection according to STANAG 4569. The armoured vehicle was to be capable of transporting at least five persons. Out of the total, 20 VTV 4x4s were to be delivered to the Ministry of the Interior. However, the tender faced public criticism in that its requirements were tailored to a single pre-selected bidder. In early July 2019, the Public Procurement Office (Úrad pre verejné obstarávanie) launched an audit of the tender procedure and in November of the same year ordered the Ministry of Defence to cancel the purchase of the vehicles. The Ministry initially filed an appeal which was later withdrawn after the change of its leadership following the election in February 2020. Thus, the VTV 4x4 procurement programme was also cancelled.

Weaponry for the Heavy Brigade

Therefore, in early 2021, of the priority armament projects for the heavy mechanised brigade, only the purchases of medium and heavy trucks, as well as ZUZANA 2 self-propelled howitzers, were satisfactorily carried out. In the meantime, with the BOV 8x8



The second vehicle evaluated in the frame of the tracked IFV programme was the ASCOD offered by General Dynamics European Land Systems-Santa Bárbara Sistemas SA.



The demonstration of the ASCOD vehicle in April 2021 was accompanied by basic suitability trials performed by Slovak infantrymen.



The presentation of the ASCOD to the Slovak Ministry of Defence included not only live firing but also off-road driving at the Záhorie testing range. The same vehicle was also involved in the trials performed in the Czech Republic between April and June 2021.

and VTV 4x4 procurement projects in ashes, the Ministry of Defence re-evaluated its acquisition programmes and put emphasis on the purchase of the tracked infantry fighting vehicles within the frame of the PBV (Pásové bojové vozidlo – Tracked Combat Vehicle) programme. Among the first steps in this process was market research. Correspondingly, the Ministry began preliminary negotiations with selected companies, collecting information and preliminary offers. This was accompanied by practical tests of respective armoured tracked vehicles at the VTSÚ during spring 2021.

The first in the line was the LYNX KF41 manufactured by Rheinmetall Landsysteme GmbH from Germany. The presentation held in March aimed to present the technical characteristics, functional parameters and provide practical demonstrations in driving and shooting. The event also included talks with representatives of Rheinmetall about possible ways of involving Slovak companies in cooperation in the production and delivery of new tracked armoured vehicles for the OS SR, as well as a presentation of the current production capabilities of the state-owned company DMD Holding. During the next month, the testing range

at the VTSÚ was visited by ASCOD 42 offered by General Dynamics European Land Systems-Santa Bárbara Sistemas SA. Negotiations were again held between officials of the Ministry of Defence and the manufacturer's representatives on the production and delivery of new infantry fighting vehicles using the capacities of the Slovak defence industry. In June, a practical presentation and evaluation of the last contender took place on the VTSÚ polygon. Unlike previous companies, BAE Systems Hägglunds AB brought from Sweden to Slovakia three CV90 vehicles in the versions of armoured personnel carrier, infantry fighting vehicle and fire support vehicle.

Between 2022 and 2030, the Ministry of Defence plans to procure a total of 228 armoured tracked vehicles in two stages and in two basic sub-variants: PBOV (Pásové bojové obrnené vozidlo -Tracked Combat Armoured Vehicle) and POV (Pásové obrnené vozidlo – Tracked Armoured Vehicle). While the former will serve primarily as the platform for the infantry fighting vehicle, the latter will form the basis for a line of combat support vehicles. Originally, it was expected that three mechanised infantry battalions would be fully equipped with PBOV and POV vehicles. However, in order to save financial costs, some of the origiOverview of the required numbers of PBOV and POV armoured tracked vehicles in the first procurement phase, 2022-2026

Variant	Number of vehicles	Total number of vehicles
PBOV, infantry fighting vehicle	131	
PBOV-V, armoured command and control vehicle	15	150
POV-U, armoured recovery vehicle	3	152
POV-DTP, armoured repair vehicle	3	

Overview of the required numbers of PBOV and POV armoured tracked vehicles in the second procurement phase, 2027-2030

Variant	Number of vehicles	Total number of vehicles
PBOV, infantry fighting vehicle	5	
POV-U, armoured recovery vehicle	10	
POV-DTP, armoured repair vehicle	9	
POV-Ž - ŽP, armoured engineer vehicle	9	71
POV-Ž - MV, armoured mine launcher	9	, ,
POV-Ž - VO, armoured rocket-projected mine-clearing vehicle	9	
POV-120 ShM, 120 mm self-propelled mortar	20	

nally planned modifications (e.g. medical evacuation vehicle) will be replaced by the wheeled BOV 8x8 platform.

According to the requirements of the OS SR, the infantry fighting vehicle will comprise a crew of three, a troop compartment for at least seven soldiers, the main gun in calibre 30 to 40 mm, a 7.62 mm coaxial machine gun and an anti-tank guided missile system. The vehicle will meet the requirement for carrying supplies for a minimum of one day of combat operations without the need for resupply. The actual acquisition is going to be handled as government-to-government procurement. Thus, the Ministry of Defence sends the Request for Government Proposal to countries able to ensure the supply of new tracked armoured vehicles through national producers. Upon receipt of the responses, these offers will be evaluated and the results will be submitted to the Slovak Government for a decision on negotiations with the specific country in order to reach agreement. The evaluation of the submitted offers – a feasibility study for the procurement of PBOV and POV vehicles, together with their technical parameters and a timetable for their procurement - shall be provided to the Slovak Government by 30 June 2022.

In the first phase of the project between 2022 and 2026, the intention is to arm three mechanised infantry battalions of the 1st Mechanised Brigade and the Training and Mobilisation Replenishment Base at Martin by 2026. The total esti-

mated cost of the first phase of the PBV programme is approximately €1.739Bn, including VAT, of which the cost of 156 vehicles is some €1.512Bn, including VAT.

BOV 8x8 Project Relaunched

The Ministry of Defence restarted the BOV 8x8 (Bojové obrnené vozidlo 8x8 -Combat Armoured Vehicle 8x8) project roughly around the same as the PBV project. The main purpose of the programme is to equip a medium mechanised infantry battalion designated for operations within the frame of the NATO Readiness Initiative. At the same time, the BOV 8x8 in combat support and service support versions will be introduced into the inventory of the heavy mechanised brigade. The basic combat version of the BOV 8x8 will be a wheeled infantry fighting vehicle with a crew of three, a troop compartment for at least seven soldiers, a 30 mm main gun, a 7.62 mm coaxial machine gun and an anti-tank guided missile system. Taking into account the budgetary possibilities and priorities of the Ministry of Defence, deliveries of individual versions of BOV 8x8 will be carried out in phases. The acquisition is currently expected to take place in five stages, during which a total of 500 BOV 8x8 vehicles in 20 variants will be purchased.

The initial intention is to arm two medium mechanised infantry battalions of the Land Forces of the OS SR with 76 BOV

Overview of the required numbers of BOV 8x8 armoured wheeled vehicles in the first procurement phase		
Variant	Number of vehicles	Total number of vehicles
BOV 8x8, infantry fighting vehicle	60	
BOV 8x8 V, armoured command and control vehicle	6	76
BOV 8x8 AMBS, armoured ambulance	10	

Overview of the required numbers of BOV 8x8 armoured wheeled vehicles in the second procurement phase

Variant	Number of vehicles	Total number of vehicles
BOV 8x8 ER, armoured jammer	9	
BOV 8x8 EPZ, armoured electronic intelligence vehicle	24	02
BOV 8x8 EB, armoured electronic warfare vehicle	3	92
BOV 8x8 PVO, armoured air defence vehicle	56	

Overview of the required numbers of BOV 8x8 armoured wheeled vehicles in the third procurement phase

Variant	Number of vehicles	Total number of vehicles
BOV 8x8, infantry fighting vehicle	17	
BOV 8x8 P, armoured reconnaissance vehicle	6	
BOV 8x8 V, armoured command and control vehicle	9	97
BOV 8x8 ShM 120, 120 mm self-propelled mortar	36	
BOV 8x8 AMBS, armoured ambulance	29	

Overview of the required numbers of BOV 8x8 armoured wheeled vehicles in the fourth procurement phase

Variant	Number of vehicles	Total number of vehicles
BOV 8x8 ŠMV, armoured staff vehicle	81	
BOV 8x8 AMP, armoured personnel carrier for anti-material rifle squad	3	93
BOV 8x8 GM, armoured personnel carrier for gre- nade launcher squad	9	

Overview of the required numbers of BOV 8x8 armoured wheeled vehicles in the fifth procurement phase

Variant	Number of vehicles	Total number of vehicles
BOV 8x8 VOV, armoured recovery vehicle	13	
BOV 8x8 DTP, armoured repair vehicle	11	
BOV 8x8 RCHBO, armoured NBC protection vehicle	4	
BOV 8x8 RCHBO VPP, armoured NBC protection vehicle for search and first aid	2	142
BOV 8x8 Ž, armoured engineer vehicle	45	142
BOV 8x8 ŽMV, armoured mine launcher	29	
BOV 8x8 ŽVO, armoured rocket-projected mine-clearing vehicle	29	
BOV 8x8 ŽČC, armoured route clearance patrol vehicle	9	

8x8 vehicles in the first phase of procurement between 2023 and 2025. The cost estimate for the first stage of the project is approximately €323M, including VAT (the estimated price for actual vehicles is roughly €296M, including VAT). The estimated costs also include the price of initial logistic support, training aids, ammunition and infrastructure required for the storage, operation and maintenance of the new vehicles.

The Ministry of Defence is obliged to provide the Government with an evaluation of the submitted offers (a feasibility study for the procurement of BOV 8x8 vehicles with technical parameters of individual variants and a timetable for their procurement) until 31 March 2022. The procurement process in the following phases will depend on the production capabilities of the selected supplier and the allocated and approved budget of the Ministry of Defence. Each procurement phase will be subject to its own approval process by the Slovak Government.

The BOV 8x8 acquisition is organised in the same way as the PBV programme. Therefore, this project will be also be



Tha BAE Systems Hägglunds contender for the Slovak IFV programme is the CV 90 AFV.



Company representatives briefing Slovak Minister of Defence, Jaroslav Nad' (in blue T-shirt) on the CV90 armoured personnel carrier

handled as a government-to-government procurement process. The Ministry of Defence currently plans to approach suppliers from the European Union Members, the US and the UK. The Ministry can therefore theoretically choose from a relatively wide range of wheeled armoured vehicles. However, the actual choice will be limited for a number of reasons.

According to the current OS SR requirements, the BOV 8x8 must be equipped with an amphibious capability, which is among the most significant factors limiting the selection of candidates. In addition, the sufficiently high level of involvement of domestic industry in the production of new vehicles will be required. The Security and Defence Industry Association of the Slovak Republic required the involvement of the Slovak defence industry in the procurement process to be at least 50 per cent, with the priority to manufacture the main sections of the vehicles directly on the territory of the Slovak Republic. In the end, the Slovak Government approved a minimum share of 40 per cent (identical participation is required at the PBV project as well). Therefore, it can be assumed that the Ministry will require the BOV 8x8 to be fitted with the local TURRA 30 weapon station. This may cause problems for potential suppliers who may not have sufficient time to integrate the weapon station into their vehicles due to the tight timeframe of the acquisition's first stage. Therefore, the main candidates include the AMV (AMV XP) produced by the Finnish company PATRIA and PANDUR II 8x8 from General Dynamics European Land Systems (GDELS). Both vehicles already exist in versions with the TURRA 30 weapon station, have an amphibious capability and, in addition, have a strong industry presence in Slovakia. The former has already participated in the original BOV 8x8 tender, where it was offered by the state-owned company KONŠTRUKTA - Defence in the VYDRA variant. The latter type was presented to Slovak officials for the first time in the IFV CORSAC 8x8 version already in 2016 by MSM Martin, the Slovak branch of the CZECHOSLOVAK GROUP holding, which in January 2015 acquired the exclusive right to promote, sell and maintain PANDUR II 8x8 armoured vehicles in the Czech Republic and other selected markets in Eastern Europe and Asia. The agreement with GDELS-Steyr also included rights for licensed production of the PANDUR II 8x8 in the Czech Republic and Slovakia.

Regardless, the situation of the Slovak state treasury will be the most critical aspect for the future of both PBV and BOV 8x8 programmes. Already in late August, the Ministry of Finance warned that, given the high amount of funds needed for the purchase, the acquisition of both armoured vehicles may substantially limit the consolidation of public finances in the post-COVID period.

The first stage of the acquisition of both PBV (152 vehicles) and BOV 8x8 (76 vehicles) was approved by the Slovak Government on 8 September 2021. Unlike the original proposal, the PBV series of vehicles will be purchased without four PBOV training vehicles in the first stage and one regular PBOV infantry fighting vehicle in the second stage.



Except for the CV90 in the armoured personnel carrier version, BAE Systems Hägglunds AB presented to Slovak military officials the vehicle in infantry fighting vehicle and fire support variants.



Practical evaluation of the CV90 infantry fighting vehicle for the Slovak IFV programme took place at the Záhorie testing range in June 2021.



The CV90 in the fire support variant during the live firing trials at the Záhorie testing range

The Speed to Operate in the Digital Age An Update on Joint All Domain Command and Control

John Antal

Speed is the crux of battle. The side that can decide and act faster than the enemy has a significant advantage.

magine a single network that connects joint sensors in all domains; land, sea, air, space, and cyber and includes relevant information concerning information warfare while monitoring the electromagnetic spectrum (EMS). Now picture a setting where warfighters at all levels have access to the information pertaining to their mission and can visualize the operations and intent two-echelons above their own. Such connectivity speeds up decisionmaking and expedites the kill-chain. This is the promise of the US Department of Defence's (DoD) Joint All Domain Command and Control (JADC2) concept.

JADC2 promises to enable cross-domain manoeuvre at machine speeds using Artificial Intelligence (AI). AI can assist commanders to accelerate the "observe, orient, decide and act (OODA) loop" across the full spectrum of combat operations. According to the Congressional Research Service Report (CRS), "Joint All Domain Command and Control (JADC2), dated 1 July 2021," the DOD uses Uber as a metaphor for JADC2. "Uber combines two different apps—one for riders and a second for drivers. Using the respective user's position, the Uber algorithm determines the optimal match based on distance, travel time, and passengers (among other variables). The application then seamlessly provides directions for the driver to follow, delivering the passenger to their destination. Uber relies

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The US military is developing Joint All Domain Command and Control (JADC2) to operate in the digital age and connect the joint force.

on cellular and Wi-Fi networks to transmit data to match riders and provide driving instructions." The concept of JADC2 is to deliver digital connectivity everywhere in the battlespace. It is more than just a faster way to connect sensors with shooters. As it matures, JADC2 will operationalize battlespace data and transform transform information into understanding.

How Will JADC2 Work?

"Technology is moving fast, but human institutions and organizations aren't keeping up." MIT Sloan professor Erik Brynjolfsson, co-author of "The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies," said on 22 February 2018, at the LinkedIn Speaker Series talk. The way to keep humans operating at faster speeds is to combine humans with computer intelligence. JADC2 requires an internet cloud and a rich sensor network in the battlespace. This cloud will enable the sharing of sensor information: intelligence, surveillance, reconnaissance, and targeting data. AI will then process the data, possibly using quantum computing, to recommend courses of action and targeting options for the human commander who will command and control using JADC2. This will merge human commanders with the speed of machines. Teaming humans with computer-assisted decision-making is



The above three figures depict the complexity of war from WWII to today. The complexity of modern war, with operations executed across multiple domains and generated by smart machines, now occurs at speeds beyond human cognition. JADC2 is DOD's attempt to merge the best of human warfighting with Artificial Intelligence (AI).

often called the "centaur" concept of command and control

Some people find the centaur concept unsettling, but it can also be viewed as an evolution of what we already do today. Tomorrow, you may think of it as normal. The first human to mount a horse was probably unnerving to those who witnessed it for the first time. Those who embraced the horse developed better hunting capabilities and mounted warfare. Enemies who were unmounted were at a distinct disadvantage in speed and striking power. Humans driving cars and airplanes are part of the man-machine interface that we accept as normal today. Currently, millions of people ask guestions and get advice from devices enabled with the Lexus or Siri AI. This is a centaur approach to merge human and AI capabilities to access information to empower the human to make better, informed decisions. According to a separate CRS Study, Joint All-Domain Command and Control: Background and Issues for Congress, 8 July 2021: "As formations increase in complexity-particularly with formations designed for Joint All-Domain Operations—controlling these forces could potentially surpass the ability of human cognition, with algorithms used to help manage these forces. The US military has stated that it intends to keep humans involved throughout the decision-making process, but as US forces introduce more artificial intelligence technologies into their decisionmaking apparatus, distinctions among the dimensions begin to blur." In 2016, when JADC2 was being envisioned, Paul Scharre, an expert on autonomy in weapons and a combat veteran, wrote an article titled "Centaur Warfighting, The False Choice of Humans vs. Automation." He stated that "...in many situations, human-machine teaming in engagement decisions will not only be possible but preferable... The best systems will combine human and machine intelligence to create hybrid cognitive architectures that leverage the advantages of each." JADC2 is the evolution of that idea.

An Update on JADC2

In December 2019 and July 2020, the US military exercised multiple JADC2 elements. The first simulation involved the US Air Force's Air Battle Management System (ABMS) using joint systems from all services, including commercial space sensors. A combined wartime simulation set in the Black Sea was the focus of the second exercise. This involved joint US forces operating with eight other NATO members. The focus of both tests exercised JADC2 data sharing and simulated target engagements.

Significant investment has been dedicated to the development of JADC2. According to the CRS July 2021 report cited earlier, "DOD requested US\$302.3M for ABMS in FY2021 but was appropriated US\$158.7M (a US\$143.6M decrease) due to unjustified growth and forward financing. DOD also requested US\$207M for 5G Congested/Contested spectrum research and development, seeking to develop spectrum sharing technologies and network security architectures." JADC2 clearly is a priority for DoD.

DoD is in overall charge of the JADC2 effort, with the Joint Staff working on policies and doctrine while designating the US Air Force as the executive agent for technology development. The US Army is working on JADC2 issues under its Project Convergence programme, the Air Force with its ABMS programme, and the Navy with Project Overmatch. According to the CRS July 2021 study: "Air Force officials have argued that a JADC2 architecture would enable commanders to (1) rapidly understand the battlespace, (2) direct forces faster than the enemy, and (3) deliver synchronised combat effects across all domains."

Developing a JADC2 Common Operational Picture

A major challenge for JADC2, once the network connectivity is reliable in a contested, degraded or denied battlespace, is to develop an All-Domain Operations Common Operational Picture (ADOCOP). An ADOCOP will enable commanders to visualize multiple domains and manipulate combat actions across domains. An ADOCOP would present information at AI machine speeds to synchronise the effects across all domains in real-time, thus providing predictive analysis. This ability is crucial to assist the human warfighter in conducting cross-domain manoeuvre. A JADC2 enabled ADOCOP will enable commanders to visualize actions in the land, sea, air, space, cyber, and information domains, thus gaining awareness of friendly emissions across the electromagnetic spectrum. An ADOCOP would empower commanders to understand the complexity of the operating environment by providing autonomous situation awareness and enable decision-makers to act in real-time to employ forces and assets across multiple domains.

To conduct cross-domain manoeuvre, commanders must not only see the relevant domains on-demand, in real-time, but must also employ predictive analysis. The hyperspeed of future battle renders real-time events as past actions for human cognition. To adapt to changing circumstances, the commander benefits from enhanced cogni-



This illustration depicts the challenges of compressing the OODA Loop in the modern digital age. The OODA loop now includes sub-functions such as data collection, storage, management, exploitation. The key developers of JADC2, such as Splunk Inc., are seeking to overcome these hurdles.

tive AI to predict what is likely to happen next. Real-time is not enough; predictive analysis is crucial. As the real-time fight is occurring, the ADOCOP will help commanders visualize the fight in "predictive time" and see how their actions might play out. Visualizing all domains in one, integrated common operational picture, and providing predictive analysis, is beyond human cognition and requires enhanced systems with robust AI. An ADOCOP is an enabler for JADC2 and the human commander's interface with the AI. Those who master advanced methods to synchronize, visualize, predict, and execute combat in this multi-domain battlespace, with an ADOCOP, will secure a tremendous advantage over their adversary.

The Future of JADC2

The US military sees JADC2 as the evolution of command and control in the connected, digital age. Al is central to this evolution. Rapid data sharing can create a seamless Al assisted kill-web to allocate weapons' effects precisely, at machine speeds, across a global, adaptable, and resilient network. According to a JADC2 information paper by Splunk Inc., an American technology company based in San Francisco, California: "For the first time, it's realistic to imagine a scenario where highly advanced sensors deployed in ships, planes and tanks continually feed critical, real-time information back to headquarters. Then, using state-of-the-art AI and machine learning (ML) tools, commanders analyse the avalanche of incoming intelligence and make better decisions, faster." The key is to transform the "avalanche of data" into an ADOCOP that a human commander can understand and employ.

In June 2021, Secretary of Defence Lloyd Austin approved a JADC2 development strategy document. Lt. Gen. Dennis Crall, USMC, Director, Command, Control, Communications and Computers/ Cyber; and Chief Information Officer, The Joint Staff (J-6), announced at a press conference on 7 June 2021, that the approval of the JADC2 strategy "is a clear recognition by the Secretary on the nature of the fight we expect to have in the digital age. The second thing that is does, is that it brings together some rather disparate communities within the department and has us work together for a common cause." In response, the US defence industry is jumping into the development process. Over 90 companies, big and small, are working on aspects of JADC2. In July 2021, the US Air Force selected 29 companies as awardees for a potential US\$950M contract to develop elements of the common command-and-control platform. The other services are also investing heavily to bring JADC2 to reality. Under the guidance of the Joint Staff, the current programmes — the Air Force's ABMS, the Army's Project Convergence, and the Navy's Project Overmatch — will combine with Space Force's efforts to form America's future digital warfighting system.

War is at an inflection point as the digital age rapidly unfolds. A major shift in warfighting is taking place with the implementation of JADC2. This shift will become the warfighting agent that will combine the best of human cognition with specially programmed AI to accelerate the OODA loop, enable the kill-web at machine speeds, and extend the warfighters ability to make the whole bigger than the sum of its parts. Speed is the crux of battle, and although AI can provide speed to assist decision-making, AI cannot understand "why?" AI requires an immense amount of data to simulate understanding. Only humans can apply understanding and purpose. The best command and control system will combine human and machine intelligence to create hybrid cognitive architectures that leverage the advantages of each. Merge AI with the best of human cognition, in a centaur approach, and you have a war winning combination. This is the goal of JADC2.



Viewpoint from Warsaw



Afghan Lessons

Grzegorz Sobczak

n the second half of June this year, Polish soldiers left Afghanistan after a 20-year presence in the country. We joined the NATO operation according to Article 5 of the Washington Treaty in the aftermath of the terrorist attacks on September 11, 2001. US-led forces then ousted the Taliban from power in Afghanistan. Twenty years later, we left the country giving the opportunity to the Taliban to return to power. Some politicians in my country say that "Everything has changed and nothing has changed". But we use this expression to describe intentional action, to do a lot in order to bring things back to their previous state. Intentional... though the US and NATO achieved the same result, unintentionally. Twenty years of blood and sweat of NATO soldiers, and no result for Afghanistan – a waste of NATO lives and resources.

However, there is the other side of this coin to consider. The Polish armed forces leaving Afghanistan are completely different than in 2001. Then we were unprepared for missions like that. Without the right equipment needed for peace-keeping missions, without any wide-ranging experience or cooperation with other NATO armies - we had been NATO members for only two years (with some adapting period, however). Our engagement in Afghanistan gave us an opportunity and stimulated us to improve procedures, training and equipment. That was our lesson to learn, which we did – sometimes not perfectly, but overall, effectively. We integrated with US and NATO forces in joint combat operations, collected experience in international military operations, and became familiar with the utilisation of UAVs. We have improved the equipment of our forces such as the wheeled fighting vehicle ROSOMAK - which provided the highest level of Improvised Explosive Devices (IED) crew protection compared to all other NATO vehicles in Afghanistan.

We also paid a huge price for this lesson. A total of 44 Polish soldiers lost their lives in Afghanistan.

During the last days of August, all eyes were focused on Kabul. The great evacuation, or the great escape rather, could not be fully controlled by NATO soldiers. Some commentators have compared the situation to Saigon and the US embassy evacuation in April 1975. For me, it was rather similar to Dunkirk in June 1940, but this time, it was not military, but civilian personnel being evacuated. Similar to British Prime Minister Winston Churchill after the Dunkirk evacuation, US President Joe Biden also announced to the world that the mission had been a success. Of course, saving thousands of lives in a situation like this can be considered a success, but why did the US have to evacuate people in such a way. Wrong decisions were made earlier – soldiers leaving before civilian personnel, when the Taliban were quickly capturing the country, province by province, created all these problems later on.

Shortly before NATO soldiers left Afghanistan, some European NATO leaders such as Boris Johnson, pressured the US President to stay longer, but the scheduled end-date was not changed. This situation has shown the weakness of European NATO members. We can do nothing without the US. The potential of European NATO countries is not adequate even for our own ambitions. We are not even able to provide protection for our countries by ourselves.

In time, the US will withdraw from conflicts, probably in order to prepare for the impending rivalry with China. But Russia, which was the reason why NATO was established in the first place, will not be a US priority. It means that we need to improve our own defence potential – and that is another Afghan lesson.

For us in Poland, the decision by the US President to waive sanctions against the Nord Stream 2 pipeline linking Russia and Germany represents another signal to seriously improve our defence capabilities. The Polish Government has started a modernisation programme with the purchase of BAYRAKTAR TB2 UAVs and ABRAMS tanks. The next decisions are expected soon.

The Washington administration is facing a crisis of confidence over Afghanistan. Russia and China will use this opportunity to test where the limits of US acceptance lie for future provocative actions. One of those places can be Eastern and Central Europe. And this is also a post-Afghan lesson which we have to implement in the near future – to be prepared.

Mobile / Manoeuvre SHOrt-Range Air Defence

Jean François Auran

Short-range air defence has seen a resurgence of interest since conflicts such as those in Ukraine and Nagorno-Karabakh. What is the situation nowadays in an era of drone threat and the development of directed weapons?

Short-range air defence (SHORAD) continues to be provided by short and very short-range missiles, automatic guns, and directed-energy weapons. Protection can be mobile or by successive static deployments of short duration. Western countries have missiles inherited from Cold War programmes which continue to be improved in terms of range and seeker sensitivity while Russia and China have developed accurate weaponry over the last twenty years.

SHORAD Overview in Western Countries

The United States still markets the FIM-92 STINGER, whose production, launched in 1978, has now exceeded 70,000 units. It is manufactured by Raytheon Missile Systems and licensed by EADS and ROKET-SAN. In 2019, the US military modernised its missiles with proximity fuzes, destroying drones on impact or detonating near them. The artillerymen now use the STINGER-Reprogrammable Microprocessor (RMP). The Enhanced Target Acquisition Kit (ETAK) facilitates the acquisition and monitoring of targets day and night, even in degraded conditions. On 10 November 2020, the US Army issued a Request For Information (RFI) for its replacement and a contract should be awarded by 2026 for 8,000 missiles. Since its incorporation into MBDA, Matra has been producing the MISTRAL missile since the end of the eighties. This weapon system was the first to use a tripod. The latest version, designated MISTRAL 3, is more efficient, less sensitive to counter-measures, and benefits from a longer operational life. In November 2019, this missile intercepted a tiny target of the MIRACH 40 type, more

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In 2019, MBDA presented the ATLAS-RC. This combination with the MISTRAL missile can be fitted on light armoured vehicles, and offers effective protection for mobile combat units.

than 7 km away. It is currently in service with the French Armed Forces, with Serbia the latest of 32 countries to have purchased the MISTRAL since its commercialisation.

In Sweden, Saab has been producing the RBS70 missile since the seventies. It is often associated with the GIRAFFE radar, which has undergone a remarkable technological evolution. The RBS 70 NG possesses laser guidance that is theoretically immune to interference, unlike its competitors. The BOLIDE missile is the most advanced version with a maximum speed of Mach 2 and an effective range of up to 9,000 m. Nineteen countries have purchased more than 1,600 RBS 70 and RBS 70 NG firing units and more than 18,000 missiles.

Sweden has recently developed the RBS 98. The system consists of IRIS-T missiles from Diehl Defence in its SLM/SLS (surface launch medium-range / surface launch SHORAD) version. The Norwegian military has decided to use the same missile, reusing part of the Norwegian Advanced Surface to Air Missile System (NASAMS) C2 system to create a mobile short-range air defence system. The project includes six modified armoured combat support vehicles (ACSV) carrying IRIS-T missiles.

The British are using the STARStreak high velocity missile (HVM), manufactured by Thales Air Defence with a range of over 7 km. An order of £98.4M has been placed to equip the British Army and the Royal Marines. The UK has also recently commissioned the lightweight multi-role missile (LMM). This ammunition uses a laser beam with terminal infrared guidance and a laser proximity sensor. Members of 30 Commando (Royal Marines) have tested the LMM in ground-to-air mode against a Meggitt BANSHEE target drone.

There are ultimately only a few missiles, which operate with a multitude of platforms, radars, and associated command systems. Faced with the resurgence of significant threats, the US Army has decided to rebuild a substantial SHORAD capability. The STRYKER A1 IM-SHORAD is a new system produced by General Dynamics and Leonardo DRS, consisting of a complete weapons system on a combat-proven high mobility vehicle. The armoured car has a 30 mm automatic cannon and missile launchers capable of firing STINGER and HELLFIRE missiles. The multi-mission hemispheric radar (MHR) provides 360-degree aerial surveillance. In April 2021, the US Army deployed the first batch to Germany where the 5th Battalion, 4th Air Defense Artillery Regiment will receive a total of 40 STRYKER IM-SHORAD units. The US Army also ordered 144 STRYKERs, a part of which will undoubtedly be deployed in the Pacific theatre. The German and Dutch military use the FENNEK-SWP (STINGER Weapon Platform), but in reduced numbers. Sweden recently developed the RBS-98 mounted on the BVS10 tracked vehicle for potential operations near the Arctic Circle. The Mistral ATLAS RC comprises a remote-controlled turret, two missiles, and the latest-generation thermal sight. It can be mounted on light tactical vehicles such as the URO VAMTAC ST5 or the NIMR AJBAN 440.

Russian Equipment

Russia's defence industry has continued to develop its SHORAD capability during a period when western armed forces lost most of their skills in this field. First, we find the PANTSIR-S1 system (NATO code SA-22 GREYHOUND). This system has been rapidly improved with an S2 version with more efficient radar. Russian forces



A RBS70 NG firing unit

operate more than 140 PANTSIR S1 and S2 systems. This system has achieved export success with more than ten customers, including Burma, which ordered the PANTSIR-S1 early in 2021. Contracts are reportedly underway with new countries in the Middle East and the Asia Pacific region. This equipment has had relative success in Syria and Libya because of the inability to locate the weaponised drones effectively. Eight PANTSIR systems were destroyed in Syria and 15 (supplied by the UAE) in Libya. A modernised version, the PANTSIR SM, was presented in February 2019. The vehicle uses a KAMAZ 53958 chassis (with armoured cabin) and received a rotating AESA radar with an increased engagement range of 40 km. The PANTSIR can also be



The Polish defence industry offers POPRAD anti-aircraft systems, an armoured vehicle equipped with the PIORUN missile which is a technical evolution of the GROM.

mounted on the DT30PM tractor for the Arctic version but is not equipped with a gun in this case.

The TOR M1/2 is a high-performance, highmobility anti-aircraft system in service in 15 countries, with Russia also operating more than 200 units. This system was very effective against drones in Syria as a complement to the PANTSIR S1. The Tor-M2DT was developed for operations in the far north. The 9M337 SOSNA-R will replace the obsolete STRELA-10 systems. Without a gun, it uses 12 9M340 supersonic missiles guided by a laser beam, thus making it highly effective against fast, manoeuvring targets.

In the very short-range domain, Russia produced the STRELA missile and later the IGLA. Among the latest versions are the 9K310 IGLA-1 (or SA-16 GIMLET), the 9K38 (SA-18 GROUSE), with the latest generation being the 9K338 IGLA-S (SA-24 GRINCH). The IGLA-S has a range of 6 km with an intercept altitude up to 4.5 km. Since 2014, it has been replaced by the 9K333 VERBA missile (SA-25 WILLOW), the 4th generation of Russian MANPADS. Unveiled at the Russia Army 2015 exhibition, the country deployed this missile system in the Syrian theatre. It can be fitted with Augmented Reality to facilitate target acquisition. Russia plans to mount VERBA / IGLA-S missiles on the URAN 9 uncrewed combat ground vehicle (UCGV).

Chinese Offer

The People's Republic of China (PRC) has long copied Soviet and western equipment such as the CROTALE or APSIDE missiles. Among the many pieces of equipment in service produced for export, we can first mention the HQ-17. This is a ground-based missile system, which originated from the



The Initial Manoeuvre Short Range Air Defence System is a STRYKERbased air defence platform to replace the AVENGER system. The IM-SHORAD is more mobile, flexible, better protected, and according to soldiers, more comfortable to use than the AVENGER.

reverse-engineering of the Russian TOR-M1 (SA-15 GAUNTLET), acquired in limited quantities. It is one of the most capable SHORAD systems of the People's Liberation Army (PLA). The HQ-17AE, which is the latest model, can theoretically fire while moving, providing defence for highly mobile units. One of the latest evolutions of the HQ-17 is the FL-2000 unveiled at the 2018 Zhuhai Air Show.

Derived from the HQ-7 (French CROTALE), the FM-90 can engage targets at ranges up to 15 km. It is mounted on a 6x6 light armoured personnel carrier. Bangladesh has acquired four of these systems.

In the MANPADS field, Chinese activity is diverse and challenging to follow due to confusing terminology. The PRC has long produced the HONGYING missile, which is still in service in several countries. The FN/FY-6/16 family's latest development remains among the most advanced Chinese missiles available for export. They use multispectral IR / ultraviolet sensors and advanced countermeasures. In August 2021, Pakistan ordered 140 more FN-16 missiles even though the local press pointed to problems with the reliability of Chinese systems. The HN-6 is a further development of FN-6 and FN-16.

In the early 1990s, Chinese industry unveiled the QW-1 VANGUARD, a new generation of missiles. Several models were successively developed and produced. The QW-2 VANGUARD 2 entered service in the early 2000s, and the QW-12 can be considered the equivalent of the Russian IGLA-S. The QW-19 was first shown at Air Show China 2014. The QW-4 has been in service with the PLA since 2007, but only limited information is available. Many countries have acquired these missiles, including Turkmenistan and Bangladesh, which have received the QW-2. Chinese manufacturers have installed their missiles on many vehicles, such as the DONGFENG EQ2050 or the TD-2000 system.

Revival of Self-Propelled Anti-Aircraft Weapons (SPAAG)

The development of self-propelled guns, which has been at a standstill for a long period of time, could restart due to increasing threats of all types. We can cite tactical drones, loitering ammunition and of course, all types of aircraft. European armies no longer have SPAAG except for a few Romanian GUEPARD or MARKSMAN systems.

Among the most promising projects is the adaptation of the 40 mm CTA gun to a 6x6 truck that gave birth to the RAPIDFIRE, although it has not found a buyer yet. Rheinmetall offers the BOXER SPAAG fitted with the Oerlikon SKYRANGER air defence turret. It is armed with Rheinmetall's 35 mm x 228 calibre gun, with Advanced Hit Efficiency And Destruction (AHEAD) ammunition, optimised for air defence. The gun has a cyclic rate of fire of 1,000 rounds a minute, with a typical aerial target burst of 20 to 24 rounds. China recently revealed a new type of self-propelled, eight-wheeled 35-mm anti-aircraft gun equipped with two surface-to-air missiles. South Korea's industry developed and will mass-produce a newly developed 30 mm (SPAAG) system based on the chassis of the Hyundai ROTEM K808 8x8 armoured vehicles. Higher calibres may be used in the future. Russia also equipped one of its BMP3 tanks with a 57 mm AU-220M gun designed for the dual role of air defence and ground combat.

New Technologies and New Players

In Turkey, Roketsan and Aselsan have developed a short, medium and long-range surface-to-air missile family since 2007. On 26 March 2021, the HISAR-A + destroyed a target drone during a test firing. A first HISAR A + system was delivered to the Turkish Armed Forces in August 2021. Poland has long produced the GROM missile, a local version of the 9K38 IGLA. The PIORUN missile is an improvement of the GROM with a range exceeding 6 km. Poland is also producing the POPRAD anti-aircraft system mounted on the SPZR developed by PIT-RADWARE. A total of 77 POPRAD firing units were delivered between 2018 and 2021 to the Polish Armed Forces.

Serbia has the nationally designed PASARS system, which incorporates a 40 mm gun and surface-to-air missile. The previous two versions of the PASARS were first equipped with the Russian IGLA and later the MBDA-developed MISTRAL 3 missiles. The latter, called RLN-IC, incorporates a modified Soviet infrared-guided air-to-air missile VY-MPEL K-13 (R-13M).

South Korea has developed the SHIN-KUNG (CHIRON) missile, similar to the MISTRAL missile and it could have a superior performance. The rocket features integrated IFF systems, night, and adverse weather capabilities, a two-colour (IR/UV) infrared seeker to aid in negating infrared countermeasures (IRCM). During development tests, the missile scored a 90 per cent hit ratio. The SHIN-KUNG missile hit a lowflying target up to 3.5 km with a speed of 697.5 m/s (over Mach 2.36) and a range of 7 km.

The mass arrival of drones of all sizes, loitering ammunition and directed weapons will influence future systems accompanying manoeuvre forces. There have been numerous announcements but few achievements so far. The United States is finalising the development of laser-type weapons for short-range surface-to-air defence. A team of army engineers from The Army Rapid Capabilities and Critical Technologies Office (RCCTO) is developing two combat lasers, classes of 50 kilowatt-class weapons to be attached to STRYKER vehicles for combat deployment by 2022. The battery, power and cooling system are all self-contained in the (Directed Energy) DE M-SHORAD system. The Army recently tested such systems at Fort Sill, Oklahoma.

To conclude, SHORAD is currently experiencing renewed interest in western countries while Russia and China have understood the importance of maintaining significant resources in this area. The fifth generation of MANPADS is due to arrive soon, at the same time as the first directed weapons. It is clear that ground-to-air defence is multi-layered by nature with a mix of different systems and weapons. Warfare is also a way forward with the full spectrum of measures to cut the links between a drone and its operator.

Vehicle Equipment of the Luxembourg Army

Gerhard Heiming

The Luxembourg Army aligns its equipment with the commitments it has made to NATO (NATO Defence Planning Process, NDPP) and the European Union.

With a personnel strength of around 1,000 military and civilian members and an annual budget of \notin 426M (2021), the Luxembourg Army is the smallest in NATO and the EU. Luxembourg is a founding member of both Organisations and integrated into their common defence. The armed forces, on the scale of a regiment, are led by a general. The soldiers serve exclusively on a voluntary basis.

Mission

The main national missions are contributions to territorial defence and the protection of critical infrastructure. In addition, administrative assistance is provided, e.g., in the event of disasters. In the international context, the Luxembourg Armed Forces participate with contingents in common collective defence in association with the international organisations of which Luxembourg is a member. Furthermore, participation in humanitarian and evacuation missions, peacekeeping missions, and crisis response operations, including peacemaking, as well as the review and monitoring of the implementation of international treaties to which Luxembourg is a party, are part of the army's tasks.

By way of preparation, members of the armed forces are assigned on a voluntary basis to so-called units of operational readiness (unités de disponibilité opérationnelle, UDO), which can be deployed at short notice for international tasks.

The Luxembourg Armed Forces have participated in all major NATO and EU missions, as well as in UN missions with contingents of varying strength. Current examples are the participation in the European Training Mission in Mali (EUTM) and in MINUSMA, in the NATO Battlegroup in Lithuania in the framework of the enhanced Forward Presence (eFP), in the NATO mission in Iraq, in EUNAVFOR MED Op IRINI (EU) in the Mediterranean, as well as the SatCom support to the Estonian Armed Forces.



Light 4x4 AMAROK multi-purpose vehicle with four seats and large cargo compartment

Resources

The Defence Minister's budget for army operations and equipment has more than doubled in the past decade. In 2020, €388M were made available or 0.6 per cent of the gross domestic product (GDP). That may seem small, given NATO's demand of two per cent per member country. However, the comparatively high GDP in Luxembourg leads to defence spending of €567 per capita. Montenegro, which is comparable in population size, comes to €116 per capita with a budget amounting to 1.8 per cent of its GDP. Germany comes to €621 per capita at 1.6 per cent. The financial planning envisages an increase in the budget by almost half to €550M by 2024, corresponding to 0.72 per cent of GDP.

The limited resources, both in terms of personnel and budget, means Luxembourg needs to seek partners for significant projects. Luxembourg's Armed Forces have entered a strategic partnership with its Belgian neighbours, which includes joint training (e.g., of command personnel), as well as joint armament projects. This includes Luxembourg's decision to equip itself with communication and command means according to the standards of the French Scorpion programme, which is also the basis of the equipment in the Franco-Belgian Capacitè Motorisèe (CaMo) programme for modernising the capabilities of motorised units. Thales is the supplier of choice in this area.

Procurement

Luxembourg has procured an A400M transport aircraft, operated jointly with Belgium from the Melsbroek air base north of Brussels. Belgium also represents Luxembourg in the programme organisation at OCCAR. With the A400M, Luxembourg participated in the evacuation of refugees from Afghanistan in August 2021. In the creation of the Multinational MRTT Unit (MMU), Luxembourg is one of the founding members. After participation was extended in 2020, 1,200 flight hours per year have been agreed for Luxembourg. In May 2021, the first operational flight for Luxembourg transported the contingent for EUTM to Mali.

Wheeled Vehicle Programmes

For wheeled vehicles, the Luxembourg Armed Forces have embarked on a modernisation programme in which the main elements of the existing equipment will be renewed over a period of two decades. The focus is on three equipment programmes.

AMAROK Multi-Purpose Vehicles

In July 2021, the Luxembourg Army took delivery of a total of 23 VW AMAROK multi-purpose vehicles. As a result of a competition, the authorised VW dealer Garage Losch, Luxembourg, was selected as the main contractor.

The vehicles were ordered in two variants: 20 Light Multi-purpose Vehicles (LMPV) and three tactical ambulance vehicles (Ambulance tactique).

In cooperation between Losch and the Dutch vehicle supplier Modiforce as subcontractor, 20 LMPVs were built according to the requirements of the Luxembourg Army. The 2.3-tonne vehicles are powered by a 3 I V6 diesel engine with 150 kW of emission class Euro VI via an automatic transmission. Four people can be transported in the cabin. The cargo compartment in the rear holds about 2



Medium protected ambulance vehicle 6x6 EAGLE V for the protected transport of two injured persons

m³ of cargo. The load in the rear is protected against the weather by a hardtop, which is accessible from the rear on full cross-section and on both sides via flaps. Together with 175 kg roof load, a payload of 750 kg can be transported. With 20 cm ground clearance and 50 cm fording depth, the all-wheel drive LMPV can be used off-road.

The vehicle is air transportable with lashing eyes and approved for transport in the A400M (air clearance). Special military equipment includes a second (radio) battery, a 24-volt power supply (in addition to the 12-volt power supply), Thales radios, towbars to civilian and NATO standards, and the blackout light switch, which turns off all lights and turns on camouflage lighting.

Photo: Heim



DINGO 2 pick-up with SatCom liaison unit in swap body

The three Ambulance tactique vehicles were built by Losch together with the Finnish ambulance vehicle supplier Tamlans. In the extended chassis variant, the wheelbase was increased from 3,090 mm to 3,490 mm, a more powerful diesel engine with 188 kW as well as air suspension on the rear axle were installed. The total weight was increased to 3.5 tonnes. In the treatment room, a lying and a sitting patient can be accommodated and cared for by a medical professional. The necessary equipment is available and can be operated while driving. Additional batteries are available for this and for the military radio, which can be connected to the vehicle battery.

The procurement contract includes an agreement on manufacturer service during the first five years of operation. A total of almost €3M was spent on this project.

Protected Ambulance Vehicle (PAV) EAGLE V

In June 2021, four medium protected ambulance vehicles based on the 6x6 version of the EAGLE V were ordered from General Dynamics European Landsystems (GDELS). In its technical description, Luxembourg closely followed the specifications of the German procurement office, which concluded a procurement contract for 80 ambulances at almost the same time. Thus, despite the small order, it was possible to agree on the same price as for the German "large order". The estimated €15M include the built-in medical and electronic equipment. The vehicle can transport two lying wounded and medical personnel side-by-side.

Differences exist in communication equipment and jammers, which are supplied by the subcontractor Thales, in medical equipment and in the additional rescue and recovery kit (e.g., spreader, cut-off grinder), which can be used to free patients from the vehicle. The PAVs are due to be delivered from 2023 onwards.

Command Liaison and Reconnaissance Vehicle (CLRV)

In June 2021, the Luxembourg Minister of Defence, François Bausch, presented a plan for the procurement of 80 protected armoured command, liaison, and reconnaissance vehicles (CLRV).

The new vehicles will replace a total of 90 obsolete protected vehicles – 42 High Mobility Multi-purpose Wheeled Vehicles (HMMWV) HUMMER and 48 Protected Reconnaissance Vehicles (PRV) DINGO 2 – from 2024 onwards. The aim of the procurement project is to ensure uniform equipment at company level and closer alignment with the privileged partner Belgium to achieve advantages in deployment, training, and logistics over 15 to 20 years with interoperable and compatible equipment.

For the procurement, Luxembourg has called in the NATO Support and Procurement Agency NSPA. Within the specified ceiling of \in 367M, about onesixth (\in 61M) is earmarked for platform procurement, one-third (\in 122M) for electronic equipment including radios, jammers, sensors, and armament, and about half (\in 184M) for operational logistical support.

The tender, dated 1 July 2021, calls for a market-available 4-door military off-theshelf (MOTS) vehicle with a maximum unladen weight of nine tonnes and a possible payload of 1.5 tonnes. The payload includes mission equipment and the fourperson crew with equipment. Propulsion is required to be a 200 kW, 6-cylinder diesel engine (minimum Euro III) capable of a top speed of 100 km/h on solid road via a fully automatic transmission. The electronic/electrical architecture shall comply with the Scorpion architecture and ensure self-sufficient operation of the equipment for at least two hours. The vehicle shall be divided into a protect-

ed cell for the crew and an unprotected cargo compartment with a volume of 1.5 m³. The basic protection against ballistic threats according to Level 1 (STANAG 4569) can be increased as required with easily mountable add-on elements. The



Logistics truck 8x8 Scania G480 loaded with AMAROK on swap body

level of protection to be achieved was not communicated, nor was the level of protection against mines and blasts. For self-protection, the CLRV is equipped with a Remote Weapon Station (RWS). Protection also includes NBC protection ventilation, which is combined with the air conditioning system.

The decision on the selection of a bidder is to be made in 2022. A first vehicle lot with a total of ten CLRVs with RWS is to be delivered by 30 April 2024 at the latest. A subsequent lot with a total of 30 CLRVs with RWS is expected to be delivered by 31 October 2024 at the latest in order to achieve an initial capability from 1 January 2025. After completion of all deliveries by 31 October 2025 at the latest, full operational capability is planned to be achieved from 31 December 2025.

DINGO 2 Support Vehicles

In 2010, Luxembourg procured 48 Protected Reconnaissance Vehicles (PRV) based on the DINGO 2 from Krauss-Maffei Wegmann. These vehicles are being replaced by the CLRV described above due to obsolete weapon systems and electronic equipment.

In subsequent years, a further 15 DINGO 2s were procured, which remain in use independently of the CLRV. These include a protected ambulance vehicle, two vehicles for SatCom connections, two recovery vehicles with winches, four command vehicles and six light transport vehicles. Some of the DINGO vehicles are pick-up trucks with mission equipment in interchangeable bodies.

Multi-Purpose Logistic Support Truck (MLST) Scania G480

For logistic tasks, 31 Scania G480 Multipurpose Logistic Support Trucks (MLST) are available. Three of them are designed as recovery vehicles and equipped with Empl's BISON recovery equipment.

These 8x8 vehicles are powered by a 353kW diesel engine that complies with the Euro V emission standard. Ten of the 28 transport trucks are equipped with a protected cab from Centigon. With a total weight of 39 tonnes, 22 tonnes are available for payload (18 tonnes with protected cab). Container carrying frames enable the transport of ISO containers. With Xframes for container handling and hooks for flatracks, loading and unloading is done without external assistance.

There are currently no plans to replace the vehicles. Modernisation is conceivable once the procurement measures described above have been completed.

Result

The renewal of a substantial part of its vehicle fleet enables Luxembourg to provide medium forces for the performance of national and international tasks. In doing so, the country is cooperating with competent partners to procure reliable equipment with low risk.

USAF's Next Generation Air Dominance Programme

Status Report and Impact

Sidney E. Dean

The United States Air Force (USAF) is currently developing the Next-Generation Air Dominance (NGAD) tactical aircraft system. The 6th generation NGAD will ultimately replace the 5th generation F-22 RAPTOR as USAF's primary air-superiority asset.

NGAD is frequently thought of as the next generation fighter aircraft, and even USAF leaders tend to discuss it in such terms. Formally, the Pentagon describes NGAD as a "family of capabilities that enable air superiority in the most challenging operational environments (...) [NGAD] is an advanced aircraft programme for development of penetrating counter-air platforms with multi-domain situational awareness, agile resilient communications, and an integrated family of capabilities." Space, cyber and electronic warfare elements are expected to integrate into the NGAD system.

Information Drip

Details of the NGAD design, technology and objective capabilities profile remain classified - and will for some time - but the Pentagon has made general statements. The family of systems will include manned and unmanned elements. The manned fighter at the centre of the NGAD system will most likely include the capability to be operated in unmanned mode as well. The aircraft will have greater range and payload capability than the F-22 RAPTOR (no great surprise given widespread criticism of the F-22's unrefuelled combat radius). Unmanned aircraft carrying additional ordnance and sensors are expected to escort the manned fighter, significantly increasing the combat power of a single flight.

What appears to be a computer screenshot was released in March 2021 as part of the Department of the Air Force's latest biennial acquisition report, sparking considerable interest. The image depicts a twin-engine blended wing aircraft with an internal weapons bay (all of which would come as no surprise on a 6th generation aircraft which is generally



Retirement of the F-22 RAPTOR is slated to begin circa 2030, but will take more than a decade to complete.

expected to be stealthy in all aspects). Despite initial hopes that USAF might be revealing details of the future fighter's design, it remains unclear whether the illustration actually represents the current NGAD manned prototype. The image – which depicts alternate engines, landing gear and payloads being interchanged – could simply illustrate the digital design aspect of the development programme. Given USAF's declared intent to prevent future adversaries from gaining early insights into NGAD, the released image could even be deliberately misleading.

Secrecy notwithstanding, senior leaders have provided some additional insights in recent months. While designed primarily as an air-superiority fighter, the NGAD will have a multirole capability, according to the USAF Chief of Staff, General Charles Q. Brown jr. Testifying before the House Armed Services Committee in June 2021, General Brown explained that this secondary capability would primarily permit the aircraft to defend itself against ground-to-air weapons, but would also provide "options for our air component commanders and for the Joint Force," implying that the plane could assume ground strike missions if other resources were not available. This would mirror the mission profile of the F-22.

Retired General James Holmes, who led USAF's Air Combat Command until October 2020, stated in June 2021 that NGAD may eventually incorporate two manned aircraft. One would be optimised for the European theatre of operations. It would presumably be conventionally sized, have a quick turn-around cycle, and be capable of operating from that theatre's large number of provisional airfields. A larger and heavier variant – with greater range and payload – would be configured for the Indian Ocean/Pacific theatre. In addition to this theatre-oriented difference in requirements, some experts suggest that a larger, multiple-engine aircraft – akin to a light bomber– could be armed with directed energy weapons and patrol a larger segment of airspace in any theatre, augmenting smaller manned and unmanned fighters armed with stand-off range air-to-air missiles.

Peer Player

The new plane will have a prominent role in a shrinking USAF fleet (from 4,000 tactical aircraft at the end of the Cold War, USAF's fighter force now numbers around 2,000 units). Currently, the US Air Force deploys seven different types of tactical aircraft (including three F-15 variants). Logistical concerns – including simplified expeditionary maintenance are a major element in USAF's decision to reduce the future tactical fleet to only four aircraft types. The transition is slated to take place in the 2030s. In addition to the NGAD, the future fleet will encompass the 5th generation F-35 (which will form the backbone of the force); the F-15EX (potential procurement of 140-200 aircraft replacing current F-15 variants as a "bomb truck" capable of carrying very large surface-to-surface and surface-toair payloads); and the F-16 (USAF intends to upgrade its circa 600 late block aircraft for service through the mid 2040s for multirole operations) or its ultimate low-cost "Generation 4.5" replacement. As a 6th generation air superiority fighter, the NGAD is primarily geared to competing with peer and near-peer adversary aircraft. "We need to move beyond just



An F-15EX EAGLE II assigned to the 40th Flight Test Squadron, 96th Test Wing, Eglin Air Force Base, Fla.

the Russian threat, move beyond just European basic airspace engagement ranges, and beyond 1980s and 1990s technology and defeating a mechanically scanned, single-band sensor," said General Mark Kelly, head of Air Combat Command, during an August interview with DefenseNews. "So while Russia remains a threat, we now face new adversaries, longer distances in the Asia-Pacific region and a much wider utilization of the electromagnetic spectrum. That requires long-range capabilities that can sense, shoot and thrive in a multispectral environment."

By engaging enemy air-superiority fighters, NGAD will facilitate operations by US and allied strike aircraft and bombers. In this context, the new fighter's improved payload and range will be especially valuable for operations in the far-flung IndoPac theatre of operations. In addition to supporting offensive missions, NGAD will defend friendly airspace and installations by engaging enemy strike aircraft at standoff range, optimally before adversaries can launch their own air-ground weapons.

Air Superiority in the Middle Eastern

Despite the direct focus on defeating peer-class (that is, Russian and Chinese) adversaries in the European and IndoPac theatres, introduction of the NGAD will still have significant implications for US military commitments and operations in other regions, especially the Middle East. Given the current re-focus of some Mid-



USAF is currently testing manned-unmanned teaming (MUM-T) between 5th generation fighters and unmanned combat aircraft. NGAD is expected to fully embrace MUM-T.



A 2018 concept of a 6th generation air superiority fighter

Lockheed Martin concept of a 6th Generation combat aircraft, dated 2017

dle Eastern states to deepen military cooperation with Russia and China, the United States must consider encountering 5th and even 6th generation hardware from those nations. Additionally, should a conflict escalate to a great power war, there is no reason to assume that combat would not expand into the Middle Eastern theatre. In such scenarios, NGAD will be a vital element of US power projection in the region. In case of a more permissive operational environment - sans advanced adversary aircraft - a limited number of NGAD could provide backup for larger contingents of F-35A, F-15EX, and F-16 aircraft. Regardless of theatre, USAF leadership is adamant that the next-generation technology will provide the key to sustained aerial dominance. Without NGAD, they stress, USAF would at some point be unable to retain dominance when facing cutting-edge Russian and Chinese air superiority aircraft.

The e-Series Approach

The NGAD programme utilises advanced digital design and engineering techniques to compare and test complete aircraft concepts in sophisticated simulations, exchanging and adapting individual aircraft components until optimal configurations have been determined. Only then are physical parts manufactured for real world testing (optimal construction and assembly methods for aircraft parts are also developed through simulation, shortening the time needed for physical construction). The Pentagon refers to this development strategy as the "e-Series" approach. It is intended to save both time and money by avoiding dead-end physical prototyping and experimentation. This approach enabled the NGAD office to build and test fly a full-scale technology demonstrator aircraft only two years after funding for the programme began. The flight test was revealed in September 2020 by Will Roper, who served as Assistant Secretary of the Air Force for Acquisition and Technology until early 2021. The Pentagon has declined to provide further details such as the date of the first flight, the contractor who produced the demonstrator, or whether more than one aircraft has been built; the Air Force did confirm that the plane flew with a full suite of mission systems. Although significant, this event should be taken in context. While much of the aerospace and defence press referred to the aircraft as a "prototype," the Pentagon consistently spoke of a "demonstrator." This latter term implies that the test plane is not necessarily representative of a future production aircraft. USAF's phrasing even leaves open the possibility that an existing airframe was outfitted with individual NGAD-related technologies to test their viability under flight conditions.

Perpetual Development Spiral?

The digital design revolution also opens up the option of a completely revamped acquisition strategy. Will Roper and others have proposed initiating a nearly continuous development and procurement cycle for NGAD. Rather than purchasing a full fleet of aircraft of the same design, then operating them for 30 or more years, USAF could introduce a new design every few years, and retire "older" airframes after circa 15-16 years of service. Proponents of this strategy cite several advantages.



GE expects its XA100 three-stream, adaptive-cycle turbine engine to power next-generation combat aircraft. The technology as tested provides both 10 percent increased thrust and 25 percent greater fuel efficiency compared with current engines.

These include significantly reduced operating and maintenance expenses, which would allegedly offset the increased procurement cost. According to Roper, planning a shortened service life could reduce normal sustainment costs by circa 50 percent, eliminate the need for a Service Life Extension Programme (SLEP), and reduce the need for short-term modernization and technology upgrades. A constant development cycle would also ensure that a portion of the fleet would always be at the technological cutting edge. Finally, advocates say that it would permit fielding a fleet optimized for a variety of scenarios. "I don't think it's smart thinking to build one and only one aircraft that has to be dominant for all missions in all cases all the time," Roper stated in 2020. "Digital engineering allows us to build different kinds of airplanes, and if [we] ensure smart commonality across the fleet - common support equipment, common cockpit configurations, common interfaces, common architecture, even common components like a landing gear – that [simplifies] the sustainment and maintenance in the field."

Lieutenant General Clinton Hinote, USAF deputy chief of staff for strategy, inte-

gration and requirements, confirmed in May 2021 that the Pentagon is planning a "perennial spiral" for NGAD development. As one variant enters production, the next generation will already be in the design or even the development phase, Hinote stated during an Air Force Magazine interview. This would ensure continuous maturation and fielding of the newest hardware and software, and provide the full industrial base an opportunity to participate in design and production. Each development cycle could be as short as "every five years, it could be every eight years," he said.

Whether NGAD ultimately becomes a "traditional" procurement programme or pursues a perennial spiral will be influenced by a number of capabilities and requirements studies currently being conducted. This includes a central Cost Assessment and Programme Evaluation (CAPE) of USAF's tactical airpower programmes currently being conducted by the Department of Defense. The CAPE is expected to be released by early fall 2021. Results and recommendations are expected to flow into the Fiscal Year 2023 budget request and subsequent year budgets.

Fielding Within the Decade?

Irrespective of the procurement model, NGAD appears to be moving full-speedahead. The FY22 defence budget request includes 1.5 billion USD for the programme, compared with allocations of 900 million in 2020 and one billion for 2021. These figures include funds for airframe development as well as for next-generation open mission system architecture, advanced sensors and communications, and system integration.

General Hinote stated in May 2021 that retirement of the F-22 will commence circa 2030. This will initially effect the oldest aircraft of that type; newer airframes will be upgraded (mostly with sensors, according to Hinote) and overhauled to retain viability into the 2040s as a bridge to full fielding of the NGAD capability. The general expressed doubt that a Service Life Extension Programme for the F-22 would be necessary, given the swift progress of the NGAD.

This signals strong confidence that NGAD is mature enough for an LRIP (Low-Rate Initial Production) decision in a few years time. This would mesh with General Hinote's May 2021 statement that by 2030 USAF should be deep into a new cycle of fielding NGAD.

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ARMED FORCES

The Baltic Navies: Situation Report

Conrad Waters

The re-emergence of tensions between Russia and its European neighbours has resulted in the Baltic regaining its strategic importance. Many regional navies are attempting to rebuild capabilities that they dispensed with or downgraded in the immediate aftermath of the Cold War's conclusion. This article examines the status of the efforts currently underway to rebalance naval capacity to face the renewed threat of combat in the Baltic Sea.

The German Navy has long faced a need to balance its capabilities between the demands of operations in the Baltic and the often different requirements of missions in the North Sea and beyond. In broad terms, the end of the Cold War era saw the naval requirements of the latter area prioritised alongside a broader reorientation away from high intensity warfighting towards crisis management operations. This approach has, perhaps, been best typified by the did not explicitly set out a change in policy, the ability to undertake naval combat operations in the Baltic has clearly regained its importance in recent years against the backdrop of Russian military expansionism.

Germany

The German Navy currently fields a balanced force of submarines, surface combatants, mine countermeasures vessels mence from Lürssen's Blohm & Voss yard in Hamburg before the end of the decade. Although primarily intended for blue water, oceanic deployment, all these large surface warships still have relevance in a Baltic context.

The most significant German Navy surface assets based in the Baltic are the five K130 BRAUNSCHWEIG class corvettes. A second batch of five of these anti-surface warfare orientated vessels was ordered from the



The Lithuanian Navy's JOTVINGIS and SELIS seen in the course of a NATO exercise in the Baltic. Renewed tensions in the region are driving the renewal of naval forces in the region.

substantial investment made in the F125 BADEN-WÜRTTEMERG class frigates that are currently entering service. Although Germany's latest but now somewhat dated 2016 White Paper on "German Security Policy and the Future of the Bundeswehr"

Author

Conrad Waters is a naval and defence analyst based in the UK. He is Editor of Seaforth World Naval Review, Joint Editor of Maritime Security & Defence and a regular contributor to other Mittler Report publications (MCMVs) and supporting elements. The imminent delivery of the last of the guartet of F125 class frigates alongside the planned withdrawal of the remaining F122 BREMEN class frigate LÜBECK will see the force of large surface combatants concentrated on a total of 11 F123, F124 and F125 class vessels. A number of recent announcements have confirmed modernisation plans for the older frigate classes, with a particular focus on radar system improvements. In the longer term, the contract signed with an industrial alliance headed by Damen in June 2020 for the next class of four F126 (formerly MKS-180) type frigates should see deliveries of these new ships comARGE K130 consortium in September 2017. The corvettes are being constructed in two half sections at various consortium shipyards before being integrated at Blohm & Voss, where KÖLN – lead ship of the second batch - is currently in an advanced stage of outfitting. A further three members of the batch are under construction following a keel-laying ceremony for AUGSBURG at Lurssen's Peene-Werft yard in Wolgast in July 2021. The new batch will include a number of modifications over the earlier ships, including use of a rotating variant of Hensoldt's TRS-4 multifunction radar. Receipt of parliamentary approval for the funding of a number of naval programmes in mid-2021 holds out the prospect of a further strengthening of the German Navy's capability for Baltic operations. Prominent amongst these is the project for new Type 212CD submarines that is being taken forward in conjunction with Norway. In July 2021, the programme moved to the contractual stage with the signature of agreements with ThyssenKrupp Marine Systems (TKMS) for a total of six submarines. Four of these will be delivered to Norway and two to Germany, which is expected to receive its pair of new boats in 2032 and 2034. The submarines will be derived from Germany's six existing Type 212A submarines, which were originally designed with Baltic deployment in mind and are all equipped with Air Independent Propulsion (AIP). Delivery will take the navy's submarine flotilla to a size not seen since the last Type 206 boats were decommissioned in 2011.

Other significant naval programmes that have recently moved forward include two new Type 707 replenishment oilers - successors to the existing Type 704 RÖHN class - and three replacement Type 724 intelligence gathering ships; the latter contracted with Lürssen immediately after funding approval was confirmed. Two new experimentation and support vessels are being acquired from Fassmer to replace existing ships and the combat management systems of five MJ332 FRANKENTHAL class minehunters are being upgraded. Naval aviation will benefit from the procurement of five Boeing P-8A POSEIDON maritime patrol aircraft as interim replacements for the recently retired P-3C ORIONs. Taken alongside previously-announced plans to recapitalise the fleet's helicopter assets on the basis of the NH90 helicopter, the German Navy's capabilities look set for considerable expansion over the course of the next decade.

Sweden

The future direction of the Swedish Navy and the country's wider armed forces has been set by the Total Defence 2021-25 Bill, which was published towards the end of 2020. The refreshed strategy continues the previous re-orientation of the Swedish defence establishment towards territorial defence and provides for a further acceleration of military modernisation. It is explicitly stated that, "The main focus of the navy shall be to counter an armed attack in the Baltic Sea". An important secondary objective is to maintain the integrity of the country's territorial waters.

The Swedish Navy is currently focused on a core of four submarines (forming the First Submarine Flotilla) and nine corvettes



Confirmation of the Type 212CD submarine programme will return German submarine strength to numbers last seen a decade ago.



Sweden has confirmed its commitment to the A26 BLEKINGE class submarines but it will not be until towards the end of the decade that both are operational.

(part of the Third and Fourth Naval Warfare Flotillas). A material part of this force has been out of service undergoing major modernisation in recent years. These major assets are supplemented by a number of coastal patrol boats and MCMVs, as well as by support ships and auxiliaries. Additional capabilities are provided by the mobile surface-to-surface missile batteries and naval infantry of the Amphibious Regiment. Over 100 CB-90H series combat boats and a similar number of WATERCAT M8 'G' Boat light landing craft are available to support amphibious operations. The navy has recently taken delivery of 18 improved CB90-HSM combat boats under an order placed with Saab's Dockstavarvet in mid-2017.

An important focus of recent Swedish Navy modernisation has been the upgrading and expansion of its submarine flotilla. Two linked programmes contracted with Saab in mid-2015 encompassed the midlife upgrade of two of the existing trio of GOTLAND class patrol submarines and the construction of two, next generation A26 BLEKINGE class boats. The former project has involved the insertion of a c. 2m hull plug to make space for additional equipment, installation of the latest Mk 4 iteration of the Stirling AIP plant, provision of a new suite of masts and other sensor and communications upgrades. An important aspect of the upgrades was to "prove" much of the technology that will be used in the following A26 class. Work on both



The Swedish Navy plans to embark on midlife upgrades of the VISBY class. This is KARLSTAD, the last member of the class to be delivered.

submarines – GOTLAND and UPPLAND – included in the original programme was completed in December 2020 with the return of the latter boat to the Swedish Defence Materiel Organisation. In addition, the Total Defence Bill provides for the modernisation of the third member of the class, HALLAND, to expand the submarine flotilla to five units.

Progress with the A26 programme has proceeded at a somewhat slower rate, possibly reflecting the need to rebuild fully independent submarine design and development capabilities following the Swedish submarine sector's period under TKMS ownership. It was initially envisaged that the new submarines would be delivered in the middle of the decade. However, a press release from Saab in August 2021 confirming further government investment in the project stated that deliveries "will take place in 2027 and 2028". It is envisaged that Saab will then work on a replacement for the three GOTLAND class boats. Saab have also proposed the modular A26 design as the basis for a number of export campaigns but no firm contracts have yet been awarded.

The Total Defence Bill envisages the number of corvettes remaining at nine units. The existing five VISBY class corvettes will commence mid-life modernisation over the 2021-25 planning period, receiving upgraded anti-surface and ASW capabilities as well as a longdelayed capacity to deploy surface-toair missiles. The intention is to keep the class in service until at least 2040. In the meantime, work will begin on two new "VISBY Generation 2" corvettes to replace the remaining operational pair of GÄLVE class vessels. Definition phase contracts for both programmes were signed with Saab in January 2021. The

acquisition of two additional corvettes to replace the STOCKHOLM class will be initiated before 2030.

Other planned elements of naval modernisation include mid-life upgrades and life extensions to the fleet's existing MC-MVs and a strengthening of the navy's logistics organisation. The Amphibious Regiment will be expanded by standing up a second amphibious battalion to strengthen coastal defences on the west coast around Gothenburg. The operational lives of the small TAPPER class patrol boats that often operate with the coastal defence forces have already been expanded. One potential problem area relates to the continued provision of intelligence gathering capabilities following delays to the new signals intelligence vessel ARTEMIS, which is scheduled to replace the 1980s-era ORION. Financial difficulties at the Polish shipyard contracted to build the ship's hull have badly impacted the project and a scheduled 2020 delivery date has not been met. Local press reports suggest the new vessel is currently laid up in Karlskrona whilst Saab works out the best way to complete the project.

Finland

Finland's current defence strategy and priorities are set out in the Government's Defence Report that was adopted in February 2017. Responding to the deterioration in the local security environment, this established revised policy guidelines for the maintenance, development and utilisation of Finland's defence capabilities through to the mid-2020s. In general terms, the new policy confirmed existing modernisation plans for the navy and air force whilst strengthening the capacity and readiness of land-based forces. The navy's primary missions remained the surveillance and defence of Finland's territorial waters and the protection of its sea lines of communication.

As presently structured, the Finnish Navy is focused on the combat vessels and auxiliaries of the Coastal Fleet, the coastal defence, logistic support and Special Forces of the Coastal Brigade, and the naval infantry of the Nyland (Uusimaa) Brigade. Naval combatants include a small force of fast attack craft, a number of minelaying and mine countermeasures vessels, and much larger numbers of amphibious assault ships that operate in conjunction with land-based formations. Mine countermeasures capabilities have been substantially upgraded over the last decade through the delivery of three KATANPÄÄ class minehunters between 2012 and 2016 under the "MCMV 2010" programme. Constructed by Italy's Intermarine at Sarzana near La Spezia, these c. 700-tonne vessels are derived from the Italian Navy's GAETA class. Also



An official early graphic of Finland's SQUADRON 2000 corvette.

joining the fleet over the same period were twelve new 20-metre JEHU (U-700) high-speed assault craft. Ordered from Finnish shipbuilder Marine Alutech to the firm's WATERCAT M18 AMC (Armoured Modular Craft) design, these can transport up to 24 troops at cruising speeds in the region of 35 knots.

The most important current procurement programme is the "Squadron 2020" project. This involves the replacement of seven existing or recently retired vessels - the three POHJANMAA and HÄMEENMAA class minelayers and the four RAUMAA class fast attack craft with a guartet of new corvettes. A contract for the construction of what will become the new POHJANMAA class was awarded to Rauma Marine Constructions in 2019. Fabrication of the first vessel is expected to begin in 2022 and – in spite of some delays - it is hoped that all four ships will be in service by the end of 2028. The corvettes have been designed for all year-round operation in Baltic weather conditions and will incorporate a degree of ice-strengthening for this purpose. With a full load displacement approaching 4,000 tonnes, the corvettes will be amongst the largest warships ever to serve in the Finnish Navy and are designed to provide multi-role capabilities. Sweden's Saab will have a key role in equipping the ships, supplying systems that include its 9LV CMS, SEA GIRAFFE 4A and 1X radar arrays, CEROS 200 director and new TORPED 47 lightweight torpedo. Other important equipment selections encompass BAE Systems' Bofors 57mm gun, Raytheon's surface-to-air RIM-162 ESSM and IAI's GABRIEL surface-to-surface missile.

Closely associated with the Squadron 2020 project is a mid-life upgrade of the existing four HAMINA class fast attack craft, a programme sometimes referred to as the "Squadron 2020 MLU". This will include many of the systems specified for the new POHJANMAA class so as to ensure commonality across the fleet's frontline combatants. The refits will also improve the HAMINA class's ASW capabilities to counterbalance capacity that will be lost as the existing RAUMAA class retire. As of the end of 2020, two of the class had completed modernisation. The remaining pair are scheduled to return to the fleet by the end of 2021.

Denmark

Just as for the German fleet, the Danish Navy's need to operate in Baltic waters has to be balanced with its responsibilities in the North Sea, in the waters of the more distant northern territories that form part of the Danish Realm, and in protection of the country's global maritime trading interests. Unsurprisingly, the Baltic role has been de-emphasised since the end of the Cold War, with the submarines and attack craft focused on Baltic operations now long decommissioned. Accordingly, the fleet's most potent capabilities are focused on its five large frigates, supplemented by the THETIS and KNUD RASMUSSEN class vessels largely optimised for patrolling northern waters. Although these vessels can and do operate in the Baltic, the once numerous flotilla of smaller ships optimised for territorial defence are now largely reduced to the six constabulary-focused patrol vessels of the DIANA class.

Danish defence policy is currently guided by the Defence Agreement 2018-2023. With resources heavily committed to acquiring new F-35 strike fighters, naval investment has focused on expanding the capabilities



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Denmark has reclassified its ABSALON class flexible support ships – this is ESBERN SNARE – as frigates and is upgrading their ASW capabilities.

of existing ships. This has included purchases of SM-2 missiles for the IVER HUITFELDT class in 2018 and the planned installation of additional ASW equipment in the two ABSALON class flexible support ships. The two vessels were reclassified as frigates in October 2020 in the light of these plans. However, it will not be until 2026 that the upgrades are finally complete. Preliminary plans for the development of a new class of surface warship have been revealed in the Danish press but practical realisation of any programme will likely have to wait until the next Defence Agreement.

Poland and the Baltic Republics

Current Polish defence policy for the period through to 2032 was established in the Strategic Review of 2016 and is further elaborated in The Defence Concept of the Republic of Poland published in May 2017. The defence concept gives explicit priority to the land and air forces as the key elements of Polish defence, with the navy being tasked with "...defending our coastline and denying enemy supremacy over the southern Baltic Sea." This relegation to a subsidiary, largely coastal defence role has badly impacted ambitious plans for Polish fleet renewal, which have been subject to ongoing delay and alteration. Although the 2021-2035 Technical Modernisation Plan (TMP) for the Polish Armed Forces announced in late 2019 confirmed several important naval procurement projects, actually progress has been patchy.

The situation is most serious with respect to the navy's submarine arm. A programme – known as ORKA – for new submarine acquisition has been continually deferred. Moreover, a "Plan B" involving the purchase of a pair of refurbished Swedish A17 SÖ-DERMANLAND class boats has also failed to gain traction, reportedly on cost grounds. The delay has resulted in the progressive run down of underwater capabilities as the existing elderly former Norwegian Type 207 KOBBEN have reached the end of their op-





Polish industry is making good progress with delivering the new KORMORAN class MCMVs.

erational lives. The last two members of the class were in the course of being decommissioned as of mid-2021, leaving only the 35-year old KILO class boat ORZEŁ in the fleet. It is hard to see how the submarine arm will recover from this turn of events.

Until recently, the situation with the navy's surface warship inventory has been little better. This has remained focused on two 40-year old FFG-7 type frigates transferred from the US Navy, the single Project 620 type corvette KASZUB and a trio of partly modernised Project 660M ORKAN fast attack craft. These are supplemented by a handful of MCMVs and landing craft. However, November 2019 saw the final delivery of the MEKO A-100 corvette ŚLAZĄK after an 18 year construction process. Even more encouragingly, good progress is being achieved in completing the trio of Project 258 KORMORAN II MCMVs being built by Remontowa Shipbuilding. The second member of the class, ALBATROS, was reported to have commenced trials in May 2021 and her sister MEWA was launched the previous December. Meanwhile, the maiden flight in July 2021 of the first of a guartet of Leonardo AW101 helicopters ordered in 2019 holds out the prospect of an imminent boost to the navy's ASW capabilities.

Looking to the future, July 2021 also saw the signature of an agreement with the PGZ-Miecznik consortium establishing the project for the construction of three new frigates under the MIECZNIK (SWORDFISH) programme. This represents an increase on the two units previously reported under the TMP. The project will see TKMS (offering the new MEKO A-300 PL variant), Spain's Navantia (F-100) and the United Kingdom's Babcock International (ARROWHEAD-140) put forward concept designs prior to selection of one of these ships for construction in Poland. It is intended to select a final design no later than early 2022, with an ambitious target set of having the lead vessel in the water within the following four years. The TMP also envisages the local construction of six light missile craft under the MURENA programme but there has been little news on tangible progress.

Elsewhere along the Baltic's southern shores, the navies of the Baltic Republics have been undertaking various upgrades to their MCMV forces. Notable amongst recent efforts has been the Latvian Navy's current project to reconfigure three of its TRIPARTITE MCMVs towards a MCM "toolbox" configuration with the support of ECA Group. These programmes will allow the three neighbours to retain credible countermeasures forces until a full renewal of MCM capabilities is commenced, probably towards the end of the decade. LAND AND AIRLAND DEFENCE AND SECURITY EXHIBITION

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