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US Army Priorities

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- EU Defence Cooperation
- New Risks of Digitised Wars
- Light Tactical Vehicles
- Defence Procurement in Denmark
- Manned-Unmanned Teaming
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Juncker's Heritage



The end of October marks the conclusion of the term of office of Jean-Claude Juncker as President of the European Commission. His legacy to his successor Ursula von der Leyen is largely a heap of dust and ashes. Five years ago he came to power with a fanfare for the future. The European Union was to be given a new burst of vitality, become closer to its citizens, at last put an end to its constant preoccupation with itself, and work towards solving the real problems of our times. None of these good intentions have been transformed into reality, not even notionally. Instead, the situation has become worse – a whole lot worse. This is due not least to the fact that the United Kingdom is on the verge of leaving the European Union. Brussels has been putting obstacles in the path of London every step of the way, whenever and wherever possible. The intention was deliberately not to allow an orderly exit under fair conditions. The primary goal was to make an example, to scare other Member States from taking a similar step. This calculation may have paid off. The timorous debates which had been flickering in The Netherlands, Austria and Italy about a possible departure from the EU have died down again. But the price which Brussels is paying for its no-compromise stance is a high one. Whether outside the EU, or even continuing within it, the UK is going to be difficult to live with for a long time to come. The lack of gratitude for all the services rendered to the Union during the decades of membership are not going to be easily or quickly forgotten. But Brexit chaos is only the tip of the iceberg. The real problems facing the EU are much more serious, and they have been unresolved for so long that the public at large appear to have become accustomed to them. Eastern Europeans may feel memories stirring of the years before the collapse of socialist economic mismanagement. They were aware of the fatality of the situation, but regarded it as a fate that was inevitable. In a similar way, EU Europeans today seem to have got used to their continent stagnating economically, and the threat of losing touch with the global centres of innovation. If it were not for the growth powerhouses of Eastern and Central Europe, such as Poland, Romania, and Hungary, Europe's economic performance would be looking much more depleted than it does already. At some point the question will have to be raised as to whether it really is rational to expect growth incentives from Brussels, or whether the core of the problem is actually to be sought in the over-regulating and the bad spirit of uniformity which prevails there. It is not without reason that a number of Member States, and also the States of the western Balkans, which are still waiting for a reliable prospect of accessing membership, see their interests as better served in the Chinese Belt and Road initiative. Not resolved, but likewise escaping the general public's awareness, is the Euro crisis. Negative interest rates, the purchasing of state bonds by the European Central Bank, and inflated Target 2 balances are signs of financial economic rejection, which inherently incur misallocations in terms of the real economy, imperil private assets, and set at risk the old-age provisions of millions of Europeans. Every new rescue measure which has so far seen the light of day to sustain the Community currency has simply made a bad situation worse. Magnanimous promises which two decades ago prompted citizens of the Euro Zone to allow their national currencies to be abandoned have been broken. The crisis of confidence and trust is not restricted to the European level, and in many Member States has led to populist movements of the most widely differing political orientations and radicality being able to gain influence. Jean-Claude Juncker is not to be held responsible for all these crises, but all too often he has presented a poor image in how they are being managed. Ursula von der Leyen should be afforded a better fate in this respect. Nobody should underestimate her simply because, to everyone's surprise, and like the proverbial rabbit out of the hat, she has been produced as a compromise candidate. In Germany, she held her own for six years as Minister of Defence in an office which is generally regarded as an ejector seat. Among her strengths is the ability to win political support well beyond the bounds of her own parties, the German Christian Democrats at national level and the European People's Party. As well as that, she is almost the only member of the Berlin Government who in the Trump era has succeeded in gaining a hearing on the other side of the Atlantic. With this transatlantic background she might be able to advance the security and defence policy of the EU in a way which will be understood not as an alternative to NATO, but rather as a necessary strengthening of its European pillar.

Peter Bossdorf

Light Tactical Vehicles

Photo: Oshkosh



Balancing mobility, protection and firepower **Page 42**

Legge Navale

Photo: Ministry of Foreign Affairs, Italy



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■ Airbus Delivers 1,000th SUPER PUMA Helicopter

(ck) Airbus Helicopters has delivered its 1,000th SUPER PUMA helicopter: a twin-engine multi-role H215 assembled in Marignane, France. It was handed over to the German Police to support the German Central Command for Maritime Emergen-



Photo: Airbus Helicopters

cies. This delivery completes the German Police's order for four H215s and increases the German SUPER PUMA fleet to 23, including 19 AS332 L1s, making the police force one of the largest operators of SUPER PUMAs in the world. The SUPER PUMA is operated by nearly 100 customers in 59 countries. The SUPER PUMA family comprises the H215 and H225 for the civil market where it is used in areas such as law enforcement, aerial work, search and rescue, offshore transport and governmental missions, and is well suited to operations in extreme environmental conditions. In the military sector, Airbus Helicopters offers the H215M and H225M for search and rescue, troop transport, special ops and utility missions.

■ Modular Weapon Laser

(ck) The company B.E. Meyers & Co. has added the MAWL-X1 (Modular Advanced Weapon Laser) to its family of aiming and illumination laser systems for individual and crew-served weapons in use with both military and law enforcement. Designed to address the shortcomings of common laser devices, the MAWL-X1 incorporates VCSEL technology which eliminates the



Photo: B.E. Meyers

current problem of inconsistent and granular, speckled illumination. In 2017, the company submitted the MAWL-X1 – a Flat Dark Earth, Near-Infrared / Visible MAWL featuring the EC2 threaded Endcap – to

the Soldier Enhancement Program (SEP) via the US Army Maneuver Center of Excellence. As a result, various US combat arms have fielded approximately 766 MAWL-X1 units since 2018. The MAWL-X1 is a modular design comprising three separate head, body, and end-cap components. As an ambidextrous system, it can be configured for either right or left-handed shooters. The "Alt Mount" body allows for increased versatility across multiple weapon platforms, including the M4/M16, M27, M249, M240G, and precision rifles. The MAWL-X1 is designed for intuitive operation: in the dark, under stress, and with gloves on. Featuring a simple switch mechanism with balanced power and divergence pre-sets, the MAWL-X1 allows for target transitions from close to long range in under a second.

■ Airborne Mission Management System

(ck) BIRD Aerosystems, a developer of Airborne Missile Protection Systems (AMPS) and Special Mission Aircraft Solutions (ASIO), has refined its Mission Management System



Photo: BIRD Aerosystems

(MSIS). Named MSIS 2.0, the improved version includes an intuitive and user-friendly interface with advanced multi touch-screen technology, multi-language support, and a simplified visual design that reduces the operator workload and enhances situational awareness. The improved MSIS is platform-independent, and requires minimal training. MSIS 2.0 is currently integrated on BIRD's new ASIO Maritime programme in Africa that includes special mission aircraft, patrol ships and ground C&C centre. MSIS 2.0 reduces mission crew workload by display and operation of important aspects of the mission at any given time, enabling the crew to perform efficiently the detection and classification of only the relevant targets. MSIS 2.0 addresses all the different aspects of the mission and integrates with BIRD's pre-mission analysis tools, e.g. OSCAR, which enables efficient mission planning and force allocation.

■ A "Server in the Sky"

(ck) At DSEI 2019, CONTROP Precision Technologies, a company specialising in Electro-Optics (EO) and InfraRed (IR) Defence and Security solutions, launched its STAMP-



Image: Controp

VMD, an addition to its STAMP product range, and the T-STAMP-XD. With these two solutions, CONTROP has a complete ISTAR concept – covering a large area and closing the sensor-to-shooter loop in real time. Weighing 1.3kg, the new STAMP-VMD with 'server-in-the-sky' technology is a ruggedised gyro-stabilised miniature payload for UAVs and is powered by a quiet hybrid or electric engine. The payload is designed for covert flight beneath the cloud ceiling at 1,500-3,000ft to provide video motion detection capabilities of areas as large as 1km². The payload includes an embedded processing unit that compresses and edits data before transmission to the end user, overcoming the challenges of constrained bandwidth availability. Data shown on the screen is split into three sections: a map showing the target area's location; persistent surveillance of the target area itself; and zoomable snapshots of any area-of-interest (AOI) that has been detected, to enable pinpointing of the exact area to be monitored. The system can send exact coordinates to control or to another UAV with a control payload, such as the T-STAMP-XD, to enable precision-guided munition for a direct hit of even a moving target.

■ Tactical Data Link Translation Gateway to Simplify Communications

(ck) In the field, the warfighter needs a reliable way to access information from a variety of data links. However, moving data between similar and dissimilar data links is a daunting task that can prove an obstacle to mission success. To overcome this obstacle, Curtiss-Wright, a supplier of Tactical Data Link (TDL) software and hardware, has developed HUNTR (TDL Hub and Network Translator), a software application that improves and simplifies the real-time translation and routing of TDLs. It provides warfighters and command and control centres with real-time access to operational data in the field. HUNTR's oper-

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ator-focused GUI is designed to simplify the process of managing the multiple data links used by in-field resources and command and control centres, as it provides interface and standards support. It supports touchscreen or keyboard-and-mouse operation and features a "green-good, red-bad" operator feedback scheme. Thanks to its intuitive interface, HUNTR enables access to and configuration of multiple data links with little or no training. The GUI indicates connectivity, information flow, and filtering of traffic, and enables operators to add or remove data links, and manage data flow between the links. HUNTR's filtering simplifies the control of data flow when the sending and receiving links have disparities in information capacity, or where operator "information overload" is a concern. Additionally, the software automatically converts VMF 9-lines into multiple Link 16 messages and automatically updates and maintains Link 16 PPLI and Surveillance tracks and Command and Control (C2) messages.

■ VULCANO Precision Munition Qualified

(ck) The Italian company Leonardo and the German company Diehl Defence have jointly completed STANAG-conforming qualification of their precision-guided ammunition family VULCANO 127mm and 155mm. Qualification was controlled by Italian and German authorities. The qualification performed is compatible with all Joint Ballistic MoU gun



Photo: Diehl

systems, such as the land-based platforms PzH 2000 and FH-70 as well as 127mm/5inch naval platforms. The VULCANO ammunition is designed to achieve extended ranges of 70 km for VULCANO 155 and 80 km for VULCANO 127 in conjunction with unique accuracy against stationary and moving targets. The ammunition

family reaches high target accuracy through the unique combination of satellite-based navigation with laser or infrared sensors for terminal homing which makes the VULCANO family an accurate artillery ammunition for land and naval applications. The powerful multi-role, insensitive high-explosive (IHE) warhead with pre-fragmented tungsten splinters is effective against soft targets, vehicles, semi-armoured vehicles, infrastructures and typical infantry command posts. VULCANO programming kits enable artillery platforms to fire VULCANO ammunition without difficulty.

■ Tethered Drones

(ck) Tethered drones can fly for days thanks to continuous power supply from the ground and safe communications, thereby providing ISR, tactical communications and security ca-



Photo: Elistair

pabilities at the push of a button. Recently, Elistair, a manufacturer of tethered drones for defence, public safety, and industrial applications, has integrated unmanned ad-hoc networking from Silvus into its tethered UAV platform. By uniting their expertise, Elistair and Silvus can provide mobile-networked multiple input and multiple output (MN-MIMO) networking by embedding a Silvus STREAMCASTER 4200 MIMO radio into an Elistair ORION tethered UAS. The tethered UAS provides ad-hoc networking for the battlefield, to enhance situational awareness and facilitate communications and surveillance missions. With the integration of Silvus' MANET technology, Elistair's tethered drones will help create rapidly deployable C3 networks, enabling users to share voice and data over greater distances and obstacles. Powered from the ground and flying at up to 100 metres, the ORION tethered drone now provides a combination of persistent ISR and tactical communications to increase situational awareness and connectivity. Automated, secure and with a small logistical footprint, Elistair's ORION tethered UAS is designed for extended flight times and austere environments. During recent trials and demonstrations, the STREAMCASTER equipped ORION was critical in connecting dismounted troops, vehicles, air assets and waterborne assets together over distance.

■ Integrated Long-Range Surveillance System

(ck) In modern society, the security needs of citizens are constantly increasing. Surveillance cameras with long focal lengths are



Photo: FUJIFILM

not only used to address sensitive issues such as border security but are increasingly being incorporated into public infrastructure such as airports, seaports and motorways. Long range surveillance systems must cope with special challenges; for optics with long focal lengths, the smallest vibrations can compromise the image information whilst heat haze or fog in the air also impair image quality. With its new long-range camera module FUJINON SX800, the company FUJIFILM promises to minimise the impact of these challenges. Instead of developing a surveillance camera and a separate matching lens, FUJIFILM has integrated two high-performance components – a full HD camera and an optically stabilised 40x zoom lens – into one system. Thanks to its powerful 1/1.8" image sensor, the long focal length range of 20 mm to 800 mm and state-of-the-art image processing technology, the FUJINON SX800 is well-suited for aerial surveillance. In addition to the high-quality zoom optics, the FUJINON SX800 has a powerful combined optical and electronic image stabilisation mechanism that provides angle correction of up to ± 0.22 degrees. The integrated high-speed autofocus provides a sharply focused image in less than a second, whilst a fog filter and heat haze reduction technology help prevent weather interference. The system provides consistently sharp images – even of objects several kilometres away.

■ Iveco Vehicles for Dutch Armed Forces

(ck) The Dutch MoD has contracted Iveco Defence Vehicles to provide 1,275 medium



Photo: ESD archive

multirole protected vehicles. The acquisition is part of the Defence-wide Replacement Programme of Wheeled Vehicles (DVOW - Defensie brede Vervanging Operationele Wielvoertuigen), with deliveries from 2022 until 2026. Iveco's Medium Tactical Vehicle (MTV) promises to combine tactical 4x4 mobility, off-road performance, crew protection, and a high payload capability. The MTV offers modularity across all range variants such as hard top, soft top, pick up, casualty transport and personnel transport,

in order to support various military users. Reliability, ease of maintenance and low life cycle costs were requirements during the design of MTV. Iveco has delivered many vehicles to the Dutch Army, such as the Iveco STRALIS 6x2 long haulage lorries, the TRAKKER 8x8 for the Army's Fire Department and the EuroCargo 4x4 delivered to the Dutch Marines for the Caribbean territories.

■ Multi-Calibre Assault Rifle

(ck) Israel Weapon Industries (IWI), a subsidiary of SK Group and a producer of small arms, has launched a modular rifle. The lightweight, multi-calibre assault rifle called ARAD 5.56X45mm and 300 Blackout is based on the AR15 platform. It includes several features that enable operational flexibility. The ambidextrous rifle consists of a short-stroke gas piston with a regulator in two positions, which allows optimum operation in all environmental conditions. A two-step enhanced trigger ensures shooting accuracy. Additional features include a hard-anodised monolithic aluminium MIL-STD 1913 rail in the upper receiver. The ARAD, weighing 2.85 kg, is available with barrel lengths of 292mm



Photo: IWI

(11.5") and 368mm (14.5") and will soon be offered with barrel lengths of 419 mm (16.5") and 508 mm (20"). The ARAD will also be available in additional calibres.

■ Battery Chargers for UK MoD

(ck) Lincad, a provider of batteries and battery chargers to the UK MoD, has launched an enhanced capability version of its CARAVEL Mk 2 charger. CARAVEL chargers have been in service with armed forces for 18 years, and Lincad has already received significant orders for the new four channel CARAVEL Mk2 from the UK MoD. The multi-chemistry charger is designed to meet the battery charging and management requirements of Lincad's LIPS (Lithium Ion Power System) suite of batteries, in addition to other batteries of any elec-

trochemistry, from any original equipment manufacturer. It can charge batteries ranging from 2 to 58V through a series of interchangeable BIAs (battery interface adaptors), including products not originally intended for use with a third-party charger. With the ability to work with up to four batteries at once, an entire fleet of batteries can be managed from a single type of charger. With four USB ports, it can also charge smartphones, tablets and other mobile devices, and can be config-



Photo: Lincad

ured for wireless or Ethernet communication for central monitoring. The CARAVEL Mk2 charger provides significant power delivery improvement on its predecessors, effectively halving charging times whilst delivering improved efficiency and greater flexibility in the battery types that can be recharged.



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■ Microwave Feed Assembly for Mobile Satcom Antennas

(ck) Link Microtek, a manufacturer of microwave and RF subsystems, has designed a microwave feed assembly for use in a customer's Ku-band mobile satellite-communications antenna system. Widely used around the world by news crews, first responders, government agencies and military units, such mobile antenna systems provide a quickly deployable solution for anyone requiring reliable satellite communications in remote locations. The Link Microtek assembly incorporates a feed arm, transmit and receive filters, a rotary joint and an orthomode transducer (OMT). In addition to satisfying the tight space constraints imposed by the compact nature of the antenna system, the feed assembly had to achieve strict performance criteria regarding low transmission losses and cross polarisation, as well as high isolation between transmit and receive channels. The feed arm is formed of WR75 waveguide to handle the Ku-band frequency ranges

Photo: Link Microtek



of 13.75 to 14.5GHz for transmit and 12 to 13GHz for receive. This is linked via a length of semi-rigid waveguide to a transmit filter, which bends round to interface to the rotary joint – the purpose of which is to accommodate one of the degrees of movement as the foldaway satcom system unfurls once in situ. On the other side of the rotary joint is the OMT. The function of this device is to separate the transmit and receive signals, and in conjunction with the receive filter the OMT achieves an isolation figure of over 100dB.

■ Special Lights for US Army Trucks

(ck) In May 2018, the US Army contracted Mack Defense, a subsidiary of the Volvo Group, to supply 683 M917A3 Heavy Dump Trucks (HDTs) for US\$296M. Based on the commercial GRANITE dump truck, the Mack Defense M917A3 HDT has been ruggedised with heavier-duty rear axles, all-wheel drive, increased suspension ride height and other rugged features. To meet the US Army requirements, Mack Defense has been part-

nering with Truck-Lite Co. to provide lighting systems for the M917A3 HDT. Truck-Lite is a manufacturer in heavy-duty lighting, telematics, engine protection, safety and visibility systems. Since 1998 Truck-Lite has

Photo: Mack Defense



produced military-spec lighting and will deliver blackout drive lights, front and rear composite lights and auxiliary lighting to the M917A3 HDT programme.

■ Electronic Fuse for US Bombs

(ck) The US Navy has contracted Northrop Grumman Corporation to manufacture the FMU-139D/B, a new all-electronic bomb fuse suitable for many general purpose bombs used by the US military and allied nations. With the US Navy's decision this January to authorise full rate production, the improved FMU-139D/B bomb fuse creates a uniform solution for general purpose bombs that increases performance and reliability, while decreasing cost. The FMU-139D/B replaces three legacy bomb fuses which were manufactured with technology that relied on mechanical mechanisms to arm each fuse. In contrast, the FMU-139D/B relies on electronics to safe and arm the device, greatly improving its reliability. The FMU-139D/B is easier to manufacture, assemble and test

Photo: Northrop Grumman



than other legacy fuses. FMU-139D/B will be used by both the US Navy and the US Air Force, and the Navy Program Office will manage the requirements.

■ Blast Tests for MBOMBE APC

(ck) The MBOMBE 4x4 Armoured Personnel Carrier (APC) has undergone independently verified blast tests and received final certification which exceeds NATO STANAG 4569 criteria, the highest protection level

that can be achieved by an armoured vehicle in its class. The MBOMBE 4x4 APC is a product of Paramount Group, a South African defence company; it features flat-floor mine protection technologies. The blast tests were performed with three 10 kg TNT explosions under the wheels and the hull, and one 50kg side blast test, carried out at a 5 metre distance to imitate an Improvised Explosive Device (IED). As part of the blast testing programme, the integrity of the MBOMBE 4 was subjected to post-test evaluations that took several months to complete. Key features of MBOMBE 4 also include a rear-door ramp design, which has been proven in combat on 6x6 and 8x8 IFVs. The ease of access provided by the rear-door ensures the rapid

Photo: Paramount



deployment of the crew while the vehicle is static or on the move. The MBOMBE 4 performs with a burst speed of 140km/hr, an 800km operating range and an independent suspension system designed to meet the increasing demand for outstanding protection yet adaptability in conventional and asymmetrical warfare alike. The mine resistant carrier is functionally versatile over challenging terrains and operational across missions such as counter-terrorism, border patrol, counter-insurgency, internal security and peacekeeping missions.

■ SDRs for the UK Offshore Vessels

(ck) The Royal Navy will maintain its three RIVER class offshore patrol vessels (OPV) and the OPV(H) HMS CLYDE until 2020. As these are essential for the protection of British waters, fisheries and national security, five new generation OPVs have been ordered. Three of these OPVs will enter

Photo: R&S



service with the Royal Navy by the end of 2019. For all ships, Rohde & Schwarz offers Software Defined Radios (SDR), which are designed for ship communication and feature a modular design and a high degree of flexibility. Standardised and proprietary waveforms enable secure voice and data communication in the HF and VHF/UHF frequency ranges. The R&S M3SR Series 4100 HF SDR radios belong to the SOVERON radio family, designed for use in permanently connected deployment in beyond-line-of-sight (BLOS) communications. They are installed in racks within a ship's radio room or at a shore station, where they cover long-haul ship-to-ship and ship-to-shore communications. They support frequency hopping and provide interoperability with tactical radios in HF operating modes. The R&S M3SR Series 4400 VHF/UHF radios offer military customers LOS communications with a flexible range of applications, NATO and proprietary EPM (ECCM) waveforms. Military data transmission methods such as LINK 11 and LINK 22 are supported.

■ New Combat Helmet for Dutch Soldiers



Photo: Revision

(ck) The Dutch MoD has contracted Revision, a designer of head protection systems, to supply 48,800 BATLSKIN VIPER P6N combat helmets for Dutch Military Forces. In addition, a 15-year maintenance agreement has been established, with an

estimated completion date of 2034. According to Revision the new helmet, developed to the Dutch MoD's performance standards and weight requirements, offers protection, optimised fit, reduced weight, and enhanced integration options. Revision says it is expecting other NATO countries to follow suit and upgrade their protection systems as well. The VIPER P6N helmet shell utilises advanced materials (including Ultra-High-Molecular-Weight Polyethylene - UHMWPE) and processes to allow high protection standards in a lightweight and adaptable system. More than 55,000 helmet covers in the new Dutch camouflage, "Netherlands Fractal Pattern", will be supplied in green, tan and white, and all systems will include Revision's APEX Liner system which is customisable for ultimate comfort and impact protection. Accessor-

ies include lightweight skeletonised accessory rails and the Wilcox L4 Shroud. Revision will begin delivering the helmets to the Dutch MoD in late 2019.

■ Australia Selects LYNX for Trials

(ck) Australia has selected the LYNX KF41 Infantry Fighting Vehicle (IFV) to compete in the Risk Mitigation Activity (RMA) trials for the US\$15Bn LAND 400 Phase 3 programme. The Australian Army needs a networked, protected and enabled IFV for close combat and Rheinmetall claims



Photo: Rheinmetall

its tracked LYNX KF41 is a networked and protected IFV which meets the stringent military requirements of LAND 400 Phase 3. Rheinmetall will deliver three LYNX IFVs to compete in RMA trials to be conducted in Australia. If successful, the LYNX IFV fleet will be manufactured at Rheinmetall's new Military Vehicle Centre of Excellence in Redbank near Brisbane. Rheinmetall is delivering 211 8x8 BOXER Combat Reconnaissance Vehicles (CRV) to the Australian Army from 2019 after the vehicle was selected by Australia after 12 months of RMA trials by ADF personnel in 2016-2017. Both the BOXER and LYNX are modular; the vehicles can be reconfigured to achieve many different missions with high commonality. This allows for reconfiguration of the fleets for emergent operational needs, providing greater mission flexibility, reducing through-life costs, enabling faster introduction of new technology, and optimising ongoing fleet management.

■ CAMCOPTER Tested in Finland

(ck) After being chosen for test trials by the Finnish Border Guard, Schiebel's CAM-



Photo: Schiebel

COPTER S-100 Vertical Takeoff and Landing (VTOL) UAS performed a five-day maritime surveillance demonstration aboard Offshore Patrol Vessel (OPV) TURVA. The flight trials took place in August 2019 in the Gulf of Finland. The S-100 completed given scenarios including searching, locating and recognising objects as well as surveillance for maximum situational awareness. In addition to Finnish Border Guard officials, representatives of the Finnish Defence Forces, Finnish Customs, the Ministry of Agriculture and Forestry, among others, attended the event. The test was part of the ongoing Valvonta2 project (Surveillance2) that is led by Finnish Border Guard and funded by European Maritime and Fisheries Fund (EMFF). The CAMCOPTER S-100 was selected for the shipboard trials because of its reputation as a reliable UAS for intelligence, surveillance and reconnaissance (ISR) missions. The S-100, a compact unmanned helicopter, offers a high degree of versatility and can accommodate a wide variety of payloads. To comply with its tasks, the S-100 was equipped with the L3Harris Wescam MX-10 Electro-Optical/Infra-Red (EO/IR) camera, the Overwatch Imaging PT-8 Oceanwatch wide-area maritime surveillance payload and an Automatic Identification System (AIS) receiver.

■ Long-Range Diver Delivery Craft

(ck) SubSea Craft, a maritime technology company, has unveiled its VICTA class Diver Delivery Unit (DDU) at DSEI. The craft combines the speed, range and capacity of



Photo: SubSea

a Long-Range Insertion Craft (LRIC) with the stealth and versatility of a Swimmer Delivery Vehicle (SDV). Designed around the operator, its 30kt+ speed, 250nm endurance and 2-minute transition between surface and sub-surface, enables delivery of 8 operators and their equipment to their objective, 'mission-ready', before recovering them. Easily transportable to and within an operational theatre, and interoperable with most lift assets, VICTA is designed to operate independently. It is compatible with a standard ISO container which means it can be moved discreetly to an area of operation or lifted within

the cargo bay of standard air-transport, most typically the Lockheed C130 HERCULES, or underslung from heavy-lift helicopters, typically the Boeing CH-47 CHINOOK. Propulsion is provided by a 725hp SEATEK diesel engine powering Kongsberg KAMEWA waterjets. Twin Marine Propulsion 20kW electric thrusters propel the craft sub-surface while four vertically-mounted Copenhagen thrusters provide accurate slow-speed depth control. The craft is fully fly-by-wire and will be 'flown' under water, with roll and pitch control through forward and aft hydroplanes while control in both dimensions is exercised through the same purpose-built steering columns, giving the pilot a common interface for both surfaced and sub-surface running.

■ Constant Wear Lifejacket

(ck) The two safety equipment specialists Survitec and Marine Rescue Technologies (MRT) have created a lifejacket that accommodates a range of MRT personal locator beacons (PLB). The lifejacket – the SEACREWSADER 290N sMRT – has a number of features incorporated to ensure that both the lifejacket and PLB perform in harmony for optimum performance, making

wearer is wearing heavy work gear and clothing. The lifejackets can be used in conjunction with a fall arrest harness and are ideal for workers based on offshore platforms and vessels.

■ Battle Tank Simulators for Finland

(ck) The Finnish Army has contracted Thales to upgrade their LEOPARD 2A6FIN main battle tank simulators. This is Thales's first training & simulation contract for Finland's

Photo: Thales



land forces. With the upgraded systems, the Finnish Army will have a state-of-the-art training solution incorporating virtual and multilevel simulation technologies to provide both technical instruction for crewmembers and tactical training at platoon level. The instructor station is designed to supervise up to four exercises at the same time, with up to four vehicles taking part in each exercise. The simulation includes a high-fidelity turret with gunner and commander stations, a co-located driver position and a simulated ammunition loader function. The contract is a success for Thales' AFV CORE range of armoured fighting vehicle simulation solutions. AFV CORE simulators feature an open, scalable architecture and synthetic environment compliant with international standards. Thales has expertise in simulation for land forces, having provided simulators for France's Armoured Cavalry Arm and infantry fighting vehicles (LECLERC main battle tank, VBCI, etc.), the British Army's Scout armoured reconnaissance vehicle, and the Royal Netherlands Army's largest military training platform (TACTIS).

■ New Single Piece Rubber Runflat

(ck) The runflat tyre company Tyron has added a single piece rubber runflat called Tyron ATR-SP to its product portfolio. The Tyron ATR-SP uses the same fitting equipment currently in-service with defence forces in many countries which means that both vehicle OEMs and end users can now specify their Tyron solution without the expense of investing in new capital

Photo: Tyron



equipment. The Tyron ATR-SP locks the tyre onto the wheel in the event of a blow out or an operator initiated deflation. It provides the vehicle wheel with a rubber base which can absorb the knocks that come from driving off-road and gives the vehicle crew a smoother ride. In the event of deflation from enemy action the ATR-SP ensures that the vehicle can keep moving to an area of safety, sometimes many miles away.

■ New High-Accuracy Inertial Measurement Unit

(ck) Sensoror, an established producer of tactical grade gyro sensors, gyro modules and IMUs for high-precision applications, has developed a new high-accuracy tactical-grade STIM318 Inertial Measurement Unit (IMU). STIM318 provides increased



Photo: Sensoror

accelerometer performance to support demanding navigation applications. For many applications its performance can competitively replace fibre-optic gyros (FOGs). Offering improved performance with respect to robustness, size, weight, power and cost, it is designed for use in UAV payloads, satellites, portable target acquisition systems, land navigations systems, missile navigation, and mortar aiming systems. STIM318 is comprised of 3 highly accurate MEMS gyros, 3 high stability accelerometers and 3 inclinometers. The IMU is built on the established STIM design that is field-proven in commercial and military applications.

Image: Survitech



it a comfortable solution for those requiring a SOLAS lifejacket / MRT PLB combination. The SEACREWSADER 290N sMRT version along with MRT's PLBs are all approved to SOLAS and other international safety standards. Comfort is an important factor when designing a constant wear lifejacket, as it allows offshore workers to carry out tasks unhindered by the safety equipment. With this in mind, the collaborators agreed to position both inflation mechanisms on one side of the lifejacket so that the sMRT PLB is accommodated on the other. A Fusion 3D cover over the lifejacket further balances out the symmetry for the wearer. Inspection zips have also been incorporated to each side of the lifejacket allowing the sMRT PLB to be turned on/off and the inflation mechanisms to be checked without entirely opening the lifejacket. The lifejacket's sculpted bladder is designed to inflate quickly, even if the

What Does Washington Want from NATO?

Stephen Blank

What does the Trump Administration want from NATO? This might seem to be a simple question, but actually that is not the case. To judge from the Trump Administration's rhetoric, Washington's demands upon its allies seemingly pertain exclusively to raising defence spending.

If this is so, then despite President Trump's vulgar crudity and congenitally boorish behaviour, this demand extends almost fifty years of bipartisan support since the 1970 Mansfield Amendment insisting that members of NATO pay more for defence. And an equally long-lasting trend is the failure of European governments to raise their defence spending. But more defence spending does not comprise all of what Washington evidently expects from its allies. Neither does increased defence spending alone begin to realise the depth of what Europe and Washington need from NATO and each other.

Defending Europe

Despite NATO's rightful return to an emphasis on its original purpose, defending Europe against Russian aggression and growing or at least now constant Russian threats, Washington still very much wants Europe to increase defence spending and capability to meet threats emanating from beyond NATO's borders. The current threat in the Strait of Hormuz where Iran aspires to enforce its unilateral writ over those international waters exemplifies the problem. And the failure of a European coalition to police the Straits of Hormuz like too many other previous examples of "the hour of Europe" as the former Yugoslavia war was called, also exemplifies the problem. Indeed, that failure in the Gulf could well be a har-



Photo: US Army

A US Army M1A2 ABRAMS tank fires live ammunition during the "Combined Resolve" NATO exercise at Grafenwoehr Training Ground, August 2019. "Combined Resolve" aims at improving interoperability among NATO allies.

binger of things to come unless the allies overcome the current divisions in the Transatlantic soon. As a tweet from former Swedish foreign and Prime Minister, Carl Bildt, that this author received said, "I fear the messy manoeuvres on a Gulf maritime security mission between Berlin, London and Washington is a sign of things to come. No European coherence and the US dividing." If that is the new normal then more, more constant, and deeper threats from Russia and others will regularly occur. Indeed, Russian overflights and naval probes continue without interruption from Norway to the Black Sea. And Russian capabilities are often only being recognised retrospectively, not in advance of threats, as the invasion of Crimea showed.

Disunity and Ostrichism

However what Bildt and many others have discerned is indisputably a chronic, even pervasive condition: disunity and avoidance of all responsibility in the face of challenges where force is needed to deter, wage war, or supervise or en-

force a peace process. This aversion to strategic reality now characterises too many members of NATO as does their parallel lack of capability. These weaknesses occur in both Europe and "out of area", for example the Persian Gulf. Europe has reacted supinely to the end of the INF treaty as many commentators have observed. Germany has refused to join a coalition to patrol the Straits and pressure Iran despite its piratical seizure of ships that it illegally seized from the UK and Iraq. Meanwhile, even for those allies, like the UK, who are interested in joining such a campaign, it is painfully clear that deploying forces to the Strait of Hormuz virtually denudes them as well as the US of usable capabilities in Europe or at least strains their capacities to the utmost. This revelation of a profound defence incapacity validates and justifies Washington's abiding complaint that its allies have failed to spend enough on defence and/or enhance their capabilities to confront real threats. The crisis in the Gulf also displays a refusal to embrace a common threat assessment against Iran. Furthermore it is

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clear that absent US leadership in NATO, there would probably be no unity at all among European governments on how to deal with Russia for individual governments are clearly quite divided on how to relate to the Kremlin.

No Viable Self-Defence Capability

This disunity, of course, visibly relates to and reflects European governments' seemingly congenital incapacity to meet agreed upon defence targets or to unite around a com-

This failure to reach agreed targets for defence spending is therefore a pervasive phenomenon even though recent revelations have shown that Germany's defence capability, for all intents and purposes, is non-existent. For example, Chairman of the Defence Select Committee Julian Lewis recently warned that British Armed Forces are under-resourced financially and incapable of planning effectively for the defence of British interests. Due to lack of financing the UK, in order to save its carriers, agreed to "reduce our frigates and de-

already presented a detailed analysis of the failure of post-Soviet armies, for example, former members of the Warsaw Pact except for Russia, Ukraine, and Belarus, to reform or transform themselves into capable militaries that can defend their countries. More recently, he wrote that NATO's naval capabilities are equally deficient. As he observes, "governments of the NATO countries are guilty of inattention to, and sea blindness in, modernising their navies. While among "old" NATO navies this reality is understood and documented widely, the state of development and readiness of those navies considered "new" receives considerably less attention. On examination, these new navies are deficient in building integrated capabilities, ensuring common operating procedures, projecting battlespace awareness, and accomplishing interoperability in all maritime combat domains.

Other experts have noticed similar deficiencies. Dov Zakheim, former Comptroller of the Pentagon, recently wrote that the current crisis in the Straits of Hormuz has stretched the US Navy to its limit while in the UK's case, the government has acknowledged that the Royal Navy lacks the wherewithal to protect all of its ships in hostile waters. This situation can only heighten concern about NATO's naval presence in the Baltic facing a powerful Russian threat. As Young noted, the German Navy is barely operational and Poland has underinvested in its Navy. Thus in regard to ground forces and naval forces (and presumably air forces as well) NATO as an institution may be operating today at the edge of its capabilities while threats are steadily proliferating and not only in Europe.

We should also observe here that this learned incapacity to adapt to conventional threats is linked to a similar refusal to think seriously about nuclear issues. As Nick Witney has just written, Europe's indifference to the demise of the INF treaty conforms to and extends what an earlier report has observed as an "eyes wide shut" posture regarding nuclear security issues. That ostrich-like posture could well lead Russian leaders to conclude that if they keep building nuclear and other capabilities to threaten Europe and subvert its governments as Russia is now doing, they will successfully intimidate at least one if not more European government during a crisis.

Clearly the 2% rule is insufficient. Indeed, a state can spend 2% of its GDP on its defence spending and still achieve suboptimal if not nugatory results, for example spending it all on pensions. Therefore, de-

Photo: US NATO



Jens Stoltenberg, Secretary General of NATO, and Federica Mogherini, EU High Representative for Foreign Affairs and Security Policy, have pledged to increase cooperation.

mon threat assessment for Russia, Iran, etc. This failure to develop a viable self-defence capability pertains to the famous rule that members are supposed to spend 2% of their GDP on defence. However, not only is it true that despite Russia's renewed threat, many governments, not only most Germany, have long failed to reach that target, they also have utterly failed to provide sufficient capability for their own self-defence. Worse yet, the allies are not obligated to reach this benchmark by 2024. This vacuum creates a real potential for a major threat before then. A Russian leadership, already habituated to believing itself under attack, facing long-term economic stagnation, mounting domestic political disaffection, and having effectively (albeit with diminishing returns) played the "motherland is in danger" card, may well be tempted to roll the dice in Europe before its margin of safety – given its superiority in the Baltic and Black Sea theatres – erodes. After all, similar reasoning prevailed in Hohenzollern Germany in 1914 and many states have succumbed to the temptation of a short victorious war.

destroyers from 35 ships to 32. It was never envisaged at the time of the aircraft carriers being conceived of, that we would go down to the present pathetic total of 13 frigates and six destroyers". Consequently "we're incapable of putting together a range of options to defend ourselves, which is fine as long as there is no threat and is potentially disastrous if a conflict arises as most conflicts do – unexpectedly and unpredictably." According to Sky News, the size of the British fleet has shrunk over the past three decades. Since 1982, the number of frigates has dropped from 43 to 13, while the number of destroyers has been cut in half, with the UK only possessing six now. There are also only 10 submarines instead of 16 that the Royal Navy used to have in the 1980s. Besides this, it still lacks an operational aircraft carrier because the HMS QUEEN ELIZABETH is only carrying out sea trials now. Again, we could play variations on this theme across NATO members territories. Professor Thomas-Durrell Young of the US Naval Postgraduate School has

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spite Trump's crude threats against NATO, what Washington really wants, if it were expressed more precisely, is that NATO wake up to the fact that it and its members are under constant threat of war. Russian officials and experts make no secret of the fact that they have long been at war with NATO (indeed, since 2005!) and especially the US and that they are waging this war employing what the Israeli scholar Dmitry Adamsky calls multi-domain coercion. And obviously this war comprises in large measure conventional and nuclear theatre-wide capabilities going beyond information warfare, active measures and influence opera-

even if a government meets those criteria that does not ensure the right mix of forces or capabilities in its "portfolio." Neither do these benchmarks do anything to keep overall spending priorities for that state in balance with real capabilities or real threats. Lastly, political adherence to these abstract benchmarks substitutes long-term American bullying that both preceded and will probably outlast President Trump for meaningful force planning.

To be sure, the situation has improved since 2014 when Europe, despite abundant and mounting evidence to the contrary, refused to accept that Russia was a revisionist power at war with Europe. The huge amount of literature on information warfare, active measures, and influence operations has stimulated greater understanding and more resistance to Moscow's activities across Europe. When those steps are coupled with the real measures that NATO has taken, they have, at least for now, restrained and constrained Russia's aggressive behaviour although they have not conclusively made clear to Moscow that NATO and the EU will maintain a cohesive united front. And this in spite of the fact that as Secretary-General Jens Stoltenberg has recently observed, "we are responding to hybrid

continuing unrest throughout the Middle East and the rise of an aggressive China, it is hardly surprising that Washington is increasingly hectoring its allies for support. Neither is it surprising that all too often it only hears European foot-dragging or false reassurances. Especially in light of many European states' belief that without Russia no viable European security system is feasible despite Moscow's abundant proofs that it will only accept a European security system where it has an untrammelled right to do as it wants and cannot be compelled to answer to anyone for its domestic or external conduct, the failure to provide a cohesive response to Russian threats is striking. However, given the realities of the European situation, this lack of cohesiveness can hardly be unexpected.

Washington's Demands

Therefore, while Europe largely hears from the US the demand for defence spending that it is clearly often unwilling to accept, Washington's demands actually go much deeper. Admittedly, Washington's demands are crudely formulated. But then we must also admit that there is a deeper message here. Washington demands not only that Europe spend more on its defence but also that it spends those revenues more intelligently, effectively, and cohesively. Lurking behind the demand for more spending is also a demand for European governments to become more competitive economically, more resilient – to use the current vogue word – more internally vibrant, and productive. In essence Washington is demanding that European governments, whether individually or collectively wake up to the fact that not only are the territories and sovereignty of East European states at risk, but that the values that Europe stands for and that have made it a beacon for other civilisations are also at risk.

Several years ago Dominique Moisi argued that Europe wants to be Switzerland, meaning to exit history. Given the utter unreality of such a dream and the long European indulgence in that dream, we should not be surprised to see that Europe is now paying the price for it. The upsurge of resentments, violence, and regression away from democracy represent, as some have argued, a reaction to a loss of power. Trump and his supporters in the US and Europe represent a reflection of that bitter awakening. But the way to recovery can only begin by grasping what has been lost and what is at stake not by



Photo: White House

At various NATO conferences, US President Trump has repeatedly called on the European Allies to increase their defence budgets.

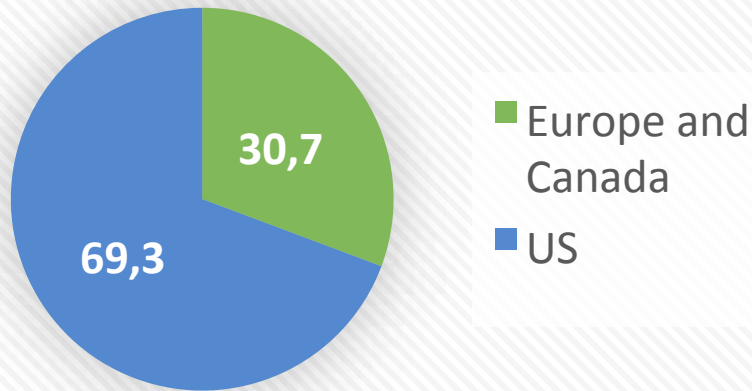
tions. Thus what the US wants is that Europe awake from its "dogmatic slumbers" and realise that, to paraphrase Trotsky, Europe might not be interested in war, but war is interested in Europe.

Specifically, the 2% benchmark and the accompanying goal of earmarking 20% of annual defence spending on major new equipment are irrelevant given intelligence estimates of NATO's actual resources relative to the Russian threat. These benchmarks do not relate to force planning and mission capabilities priorities. Indeed, they lead policymakers astray by emphasising spending more, not spending strategically or more wisely. These figures are also not based on any coherent assessment of threats or net assessment of NATO's capabilities. Likewise, they do not relate to radically different economies, force postures, comparative advantages, investment priorities and overall spending priorities of different countries. Therefore,

warfare strategies by implementing the biggest adaptation, the biggest change of NATO in a generation." Indeed, the revelations of Russian efforts to buy influence in Italy – an important NATO ally – and Austria, its incessant sponsoring of coups in the Balkans – Greece, North Macedonia, and Montenegro, and its unceasing efforts to conduct information warfare, active measures, influence operations, as well as its nuclear and conventional threats attests to an unyielding Russian effort to intimidate and subvert European governments and alliances. Nevertheless, five and a half years after the invasion of Crimea, were it not for NATO and US leadership, Europe would probably have relapsed into its self-induced somnolence and denial. Certainly the strong divisive phenomena and forces that permeate it today would have become even stronger, not least through Moscow's support for those fissiparous forces.

Therefore, and especially in the context of

NATO Defence Expenditure Share



Source: Annual Report of the NATO General Secretary, 2018

reaffirming complacency. Neither is the way forward the now obsolete Gaullist "Europe des Patries". Rather the best way to support the Transatlantic Alliance and its two wings, NATO and the EU is to advance to a more cohesive European response that realises a better version of what Europe is today and can be rather than the complacent preaching that all is well and that Europe need not defend its civilization since Washington will, or because ultimately war is supposedly obsolete.

In fact, the opposite is clearly the truth today. Therefore, Europe, to avoid becoming a political if not military battleground, must invest in robust conventional deterrence to negate Moscow's strategy at the lowest rung of its possible implementation and subsequent escalation. But it should meld those capabilities with a genuine insight into the fact that the false idea of Europe as a purely civil power does not meet the acid test of reality in today's world. Europe to recover its nerve must awake

and realise that history has not ended and that Europe is involved in that process either actively or passively. And if it prefers passivity it will lose control of its destiny to other more aggressive actors whose aims do not comport with the European project. The point of NATO, one that Russia cannot embrace in its present form, is that the members' military forces in Europe are now subordinated to a democratic principle of control and to a unity of values that strengthens them and their cohesion. It is this combination of democracy with military potency that has preserved European security and made Europe a real magnet for peoples' aspirations, including Russian aspirations. Hidden in the populism and crudity of Trump's rhetoric is an urgent appeal to Europe to recover its nerve across the board. The spate of publications arguing now for European strategic autonomy or some synonym of autonomy underscores the fact that many European thinkers have begun to see the nature of their dilemma with greater clarity. But until they and their political leaders see their plight more clearly and act on that insight, Washington will still have to make these demands on Europe. ■

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Viewpoint from Kiev



The First 100 Days of President Zelensky

Alex Horobets

Volodymyr Zelensky won a landslide victory over Petro Poroshenko in the rapid presidential elections in May this year, precisely because he called

for change. Ukrainians were frustrated that the reforms expected after the Revolution of Dignity were progressing too slowly. Voters gave Zelensky a broad mandate to bring about real change. The first 100 days of Zelensky's presidency ended in late August.

According to polls conducted by the Kyiv International Institute of Sociology, in the first 100 days people expected the new president to reduce energy costs, draft bills to waive the immunity of MPs, judges and presidents, peacefully end hostilities in Donbas, and investigate the most prominent corruption cases.

In the first 100 days of his activity Zelensky showed character and style in his leadership. With regard to the problems with Russia, the Crimea, the war in Donbas and the continuation of sanctions, Zelensky's policy is consistent with that of former President Petro Poroshenko.

A Reformer and a Populist

The new president has been described both as a "reformer" and a "populist".

Many feared that the inauguration of Mr Zelensky and his team would cause an economic crisis in the country. And such fears were understandable, for in a country in a state of war one cannot afford to make mistakes. For now, however, the situation has turned out to be quite the opposite. Volodymyr Zelensky has already implemented some successful measures. In many respects his work differs fundamentally from Petro Poroshenko's approach. Zelensky can allow himself to call Vladimir Putin, which has already happened several times, for example to discuss the situation at the demarcation line. It remains questionable, however, what this will ultimately accomplish.

One of the first outstanding decisions of Volodymyr Zelensky was the dissolution of the Verkhovna Rada of the 8th convocation and the scheduling of early elections to the Ukrainian Parliament for July. Thus the pro-presidential political force consolidated a breathtaking victory for the "Servant of the People" party and, for the first time in the country's history, forged a so-called mono coalition in the Rada, which ensured control over parliament and government.

The new Ukrainian President Volodymyr Zelensky during his first official visit to Germany, 18 June 2019

This has opened up great opportunities for Volodymyr Zelensky. Already on the first day of work of the Rada, the mono-majority demonstrated that it would not need the consent of other parties to make important decisions. And there was even some confusion amongst the other political forces. Within almost 24 hours, the Rada exchanged the leadership of the country - from minister all the way up to prosecutor general. In the days that followed, deputies used a simplified procedure to pass dozens of bills. After just a few days, Zelensky's party had completely reshuffled power in the country.

According to experts, this situation may also pose a threat to Ukrainian legislature. In particular, it's about the lack of competition in the Rada and the monopoly position of one political force. What is crucial now is whether the Zelensky team places national interests above the interests of the party. The first months of work of the new Rada give reason for cautious optimism.

On the first day of work, the new Parliament, namely the majority, initiated the first reading of the bill to abolish parliamentary immunity. In the past, the lifting of immunity had been raised repeatedly by both MPs and civil society. In the near future, the Rada is expected to debate nearly 500 other bills drafted by the president's team.

First Appointments

The first appointments have sparked criticism among civil society organisations. In particular, this concerns the appointment of Andriy Bohdan as Head of the Presidential Office. Previously, Bohdan was a lawyer for the oligarch Ihor Kolomoisky and held government posts under President Viktor Yanukovich. That is the main reason for the criticism, because Bohdan is thus subject to the lustration law. What is also somewhat strange is the fact that he constantly accompanies Zelensky on visits. He also seems to be trying to control Zelensky's actions and possibly influence his decisions. However, on his travels throughout Ukraine, the president has shown that he sharply curbs any attempts to impose opinions on him.

Photos: Presidential Administration of Ukraine



Ruslan Riaboshapka, another deputy chief of the President's Office, became Prosecutor General. In general, this appointment has received wide approval. One of the key areas of Riaboshapka's work will be anti-corruption efforts.

Aivaras Abromavicius, a well-known reformer and ex-economy minister, was appointed CEO of the Ukroboronprom State Enterprise. He was tasked with carrying out an in-depth transformation of the company and improving its public image. His Ukroboronprom reform focuses on comprehensive auditing and personnel restructuring. Abromavicius will also focus on supplying high-quality weapons to the Ukrainian Army and increasing exports of products that are competitive in foreign markets. Abromavicius has set itself an ambitious goal - to increase exports of weapons and military equipment fivefold by 2025. The head of Ukroboronprom sees aircraft construction and rocket construction as the most promising areas.

Oleksandr Turchynov was replaced as Secretary of the National Security and Defence Council by Oleksandr Danyliuk, former Finance Minister of the Government of Volodymyr Groysman. He will play a key role in security sector reform and the development of relevant legislation. Vadym Prystaiko has become a new Foreign Minister; the appointment of this career diplomat and former deputy foreign minister was not objected to.

The MoD is now headed by Andriy Zahorodniuk, former head of the Project Reform Office at the MoD which was created to coordinate changes in the defence department with the involvement of businesses and volunteers; he is also a member of the Ukroboronprom board. Also, since June, he, along with David Arakhamia and Aivaras Abromavicius, has been a member of Ukroboronprom's supervisory board. As a volunteer he had supported the ATO troops in Donbas. He dealt with the implementation of electronic procurement through a Prozorro system, criticised Soviet-style procedures in building new houses for the military and problems with food supply in the army. According to Andriy Zahorodniuk, his main priority will be the reform of the Ukrainian army and a stronger renunciation of the Soviet heritage. With the exception of Arsen Avakov, the new government consists almost exclusively of fresh new faces. Their average age is 30-40, making the new cabinet the youngest in Europe. The head of government is also the youngest in the history of an independent Ukraine. All the new ministers are well educated and have a solid reputation.

First Steps on the International Stage

In addition to the important appointments, Volodymyr Zelensky took a number of equally important steps at the international level. He restructured Ukrainian embassies and dismissed Ukrainian ambassadors to the US, Cyprus, the Vatican, Armenia, Turkmenistan and a number of African countries.

Zelensky's first overseas visit took him to Brussels, where he visited NATO headquarters and EU institutions. The president's decisions about his first overseas visits to Paris, Berlin, Toronto, Ankara and Istanbul, Warsaw for meetings with world leaders confirmed strategic partnership with the West and Ukraine's course toward rapprochement with the EU and NATO. In his meetings with world leaders, the Ukrainian President called on them to maintain and tighten anti-Russian sanctions.



Since he has been in office, President Zelensky has travelled extensively throughout the country to obtain first-hand information on various issues. Depicted is a visit to "Lesnaia" mine in the Lviv district, 29 May 2019.

Donald Trump said that the term of office of the new Ukrainian president had started very well. In return, Zelensky assured American politicians that the new government intended to introduce major reforms in the first year of its work.

The trend towards quick victories at a high price is reflected in the successful exchange of 35 x 35 prisoners of war between Ukraine and Russia. The release of the prisoners was one of Zelensky's election promises.

Among the Ukrainians who returned home were Oleh Sentsov, Oleksandr Kolchenko, Pavlo Hryb, Volodymyr Balukh, and Ukrainian navy sailors captured near the Kerch Strait. For example, the unsuccessful struggle of politicians and civil society for the release of Oleh Sentsov took more than five years. As part of the exchange, the former anti-aircraft gunner of the "DPR", Volodymyr Tsemakh, and the head of the RIA Novosti Ukraine office Kirill Vyshinsky, brought to trial for treason, was handed over to Moscow.

Politico called the exchange a "triumph" of the new Ukrainian President while Spiegel described these events as the first significant victory at the international level in Zelensky's 100 days in office.

However, the quick win has a downside. The ultimate reaction of the Netherlands regarding the handover of Tsemakh to Russia is yet to be seen. Amsterdam had formally warned Kyiv that the militant's status in MH17 downing probe was changed to "suspect". As it became known, Dutch investigators did interrogate Tsemakh before he was sent to Moscow.

Thus Volodymyr Zelensky set priorities in favour of the return of Ukrainian citizens from captivity, even at the risk of changing the balance of the international coalition in defence of Ukraine. So far, such a shift of the red lines in the negotiations with the Russians could hardly be imagined.

The main problem, however, is that the return strategy of Ukrainian citizens remains non-transparent. And for the return of other Ukrainian citizens from Russian prisons, the Kremlin could charge a price that is simply too high, not to mention the withdrawal of Russian troops from Donbas and the return of the Crimea to Ukraine.

By the way, as for Crimea, judging by Zelensky's statements, Ukraine is now developing a long-term strategy and several scenarios of action. But given Zelensky's approach to take step-by-step moves, his priority will be to restore peace in Donbas. Zelensky's position on a peace settlement in eastern Ukraine is to uphold the Minsk process and resume the Normandy format of talks. The next meeting of the Normandy Four leaders is expected to be held in the near future.

In general, Zelensky's current team, the appointments he made to the government, and the results of his first months in office show great potential for real reform. But it's too early to praise the new president. Ukraine is in a phase of great change, as the Zelensky team has received a large part of public confidence for the implementation of such a reform. In addition, several steps have already been taken that no longer allow attributing all mistakes to the previous government.

EU Defence Cooperation Programmes

Giulia Tilenni

Following the 2016 referendum on Brexit, EU countries have tried to revive (again) the common European defence policy. They therefore worked for implementing existing but unused tools, and outlined a blueprint for the launch of joint programmes. Despite these efforts, planned programmes have not been launched yet, putting the quest for further cooperation at risk.

In the last years, EU members have agreed to press defence cooperation ahead by effectively implementing the tools already included in EU treaties on the one hand, and by establishing defence-tailored funds on the other. The instruments relevant European stakeholders are developing include the revised Capability Development Plan (CDP), the Coordinated Annual Review for Defence (CARD) and the Permanent Structured Cooperation (PESCO). To incentivise member states in pursuing EU joint

Programme (EDIDP) and the Preparatory Action on Defence Research (PADR). They will probably be replaced by a more comprehensive European Defence Fund (EDF) in the 2027 timeframe.

The EU Council decision of 14 May 2019, which assessed the progress achieved in the first year following the launch of PESCO, notes that the different EU-led initiatives have already increased the aggregated defence budget by 3.3% in 2018 and by 4.6% in 2019.



Photo: BPB

PESCO and the EDF are considered crucial tools for putting EU defence into practice, as they could incentivise member states to kick-off joint R&D programmes, usually poorly funded at the national level. EU members had finally been able to launch these initiatives after two decades of impasse, mainly due to British reticence on strengthening intra-EU defence ties. The political commitment that EU states were showing appeared so strong that US stakeholders have repeatedly recalled the basic rules of the EU-NATO relationship – no decoupling, no duplication, no discrimination. However, as always happened so far on European defence, progress is deceiving compared to announcements, especially in terms of impact. As will be further explained, the Juncker Commission has tried to rapidly push EU defence forward by approving unprecedented measures. However, the fact that cooperation advance slowly (for instance for what concerns the so-called EUROMALE programme) and the nature of the projects under development demonstrates that EU tools are probably been misused because not driven by the good considerations.

PESCO and the EDF

Approved in 2017, PESCO is intended to help the 25 participants (all EU member states excluding Malta and the UK – Denmark has an opt-out clause on defence) to increase their defence budgets, harmonise and optimise their military capabilities, ameliorate the efficiency and ef-

Photo: EU / European Parliament



In a debate with MEPs, Ursula von der Leyen outlined her vision as Commission President, 16 July 2019. Some observers hope that she exerts a positive impact on future joint efforts.

programmes rather than national or multinational ones, the European Commission approved the allocation of defence-tailored funds for 2019 and 2020, namely the European Defence Industrial Development

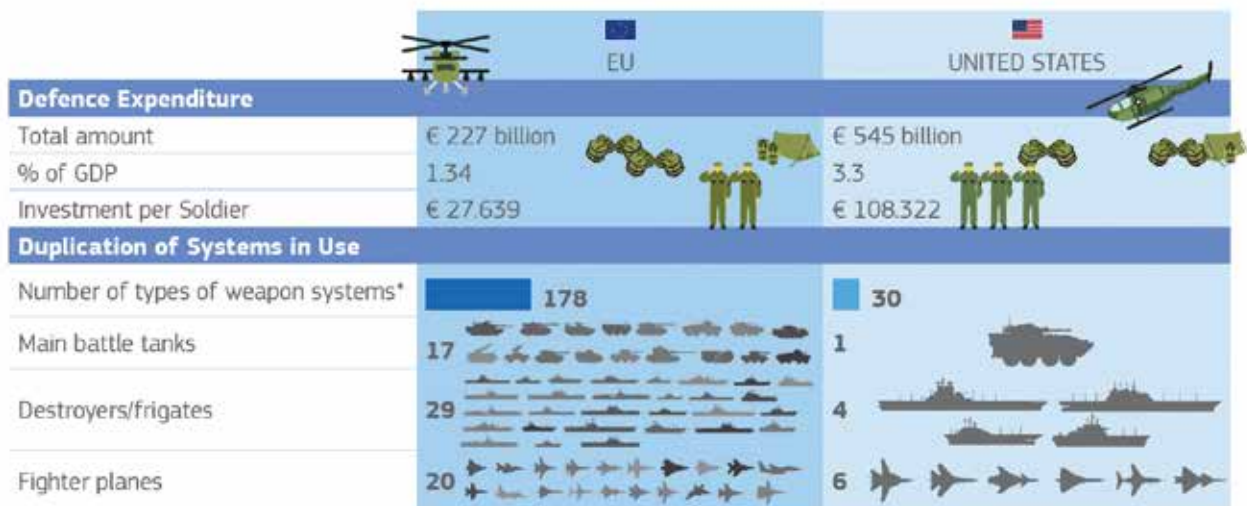
Brussels considers that defence-tailored EU funds could incentivise member states to use pooling and sharing as an instrument to reaffirm their military role. Indeed, years of underfunding have left EU states unprepared to tackle today's global threats alone. EU defence funding could push member states to reduce duplication, overcapacity and barriers to defence procurement, which cause a €26.4Bn per year waste according to EU reports.

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THE COST OF CURRENT FRAGMENTATION AND INEFFICIENCIES



* Number of types of weapon systems for selected weapon systems categories
Source: NATO, International Institute for Strategic Studies, SIPRI, Munich Security Report 2017

Graphics: EU

Collectively, Europe is a very large military spender. But it is far from being a large military power. This is because of inefficiencies in spending and the untapped potential of working together on planning and procurement.

fectiveness of their armed forces and to reinforce the EU defence industrial base and strategic autonomy. The fact that participants bind themselves to develop the programmes chosen among the 34 available is an innovation for European defence, so far implemented on a voluntary basis only. Nevertheless, as already discussed in ESD 02/2018, the military impact of PESCO will likely be limited. This form of cooperation is not the first step towards the creation of a common European army – as stated by High Representative/Vice-President Mogherini. Nor is there any ambition to create rapid intervention forces that can replace/integrate EU Battlegroups – which have never been redeployed for combat missions so far. Furthermore, PESCO projects with the largest number of participants are not necessarily those with the greatest military interest/impact, rather being the most politically shared or the easiest to be completed. The Military Mobility project and ESSOR are two emblematic examples. The Military Mobility project intends to ameliorate mobility across Europe by better adapting existing infrastructures and by harmonising relevant regulations and provisions. It has 24 participants, but it will have a very limited impact on European defence per se. Worse still, the programme favours the redeployment of US troops in Europe. The ESSOR (European Secure Software defined Radio, ESSOR) project, which could increase European strategic independence in the field of secure military communications, has only 9 participants. The most ambitious projects added with the second batch (approved

in November 2018) essentially follow the same scheme.

In order to step-up European defence cooperation, the European Commission proposed to include a defence-tailored fund, the European Defence Fund (EDF), in the 2021-2027 Multi-annual Financial Framework (MFF). The Council and the Parliament reached a political agreement on the fund in February 2019, but the final amount, as well as the participation of third countries, will be further discussed during the negotiations on the MFF. Should the current proposal be confirmed, €13Bn (about €2Bn more than previously expected) will be allocated for defence programmes over a seven years-long period. They should be ideally shared between research (€4.1Bn to finance competitive and collaborative projects, mainly through grants), and capability (€8.9Bn to be mainly dedicated to prototypes and certifications). In order to be funded, projects must respond to member states' priorities agreed to at the EU level and be carried out by at least 3 participants from 3 states. The cross-border participation of SMEs and mid-caps will be particularly welcome. The research and design phase can be funded up to 100%, testing, qualification and certification actions up to 80% and prototype development up to 20%. PESCO projects, which development is considered as a priority due to their EU nature, could receive an additional 10% funding (from 20% to 30%). Between 4 and 8% of the total EDF budget will fund disruptive, high-risk innovation that will boost Europe's long-term technological leadership and defence autonomy.

The MALE RPAS

The development of the MALE RPAS, the Medium Altitude, Long Endurance Remotely Piloted Aircraft System also known as EUROMALE or EURODRONE, could have represented a first remarkable example of European cooperative programme. However, its future is now questioned as it is an ambitious programme that could finally fail. OCCAR formally launched an invitation for tender for the development of a European-produced MALE RPAS in October 2018, following the successful completion of the two years-long, €65M worth definition phase launched by Italy, Germany, France and Spain in 2016. Airbus Defence & Space GmbH was identified as prime contractor, while Airbus Defence & Space S.A.U., Dassault Aviation and Leonardo were selected as major sub-contractors. System integrators Elettronica, Hensoldt, Indra and Thales formalised an offer for a coherent ISTAR functional chain for the programme some months later. According to the original schedule, the signature of the contract is expected in the fourth quarter of 2019, to be shortly followed by the launch of the development, production, and initial in-service support. This might allow a prototype flight in early 2023, and to deliver the final system in 2025.

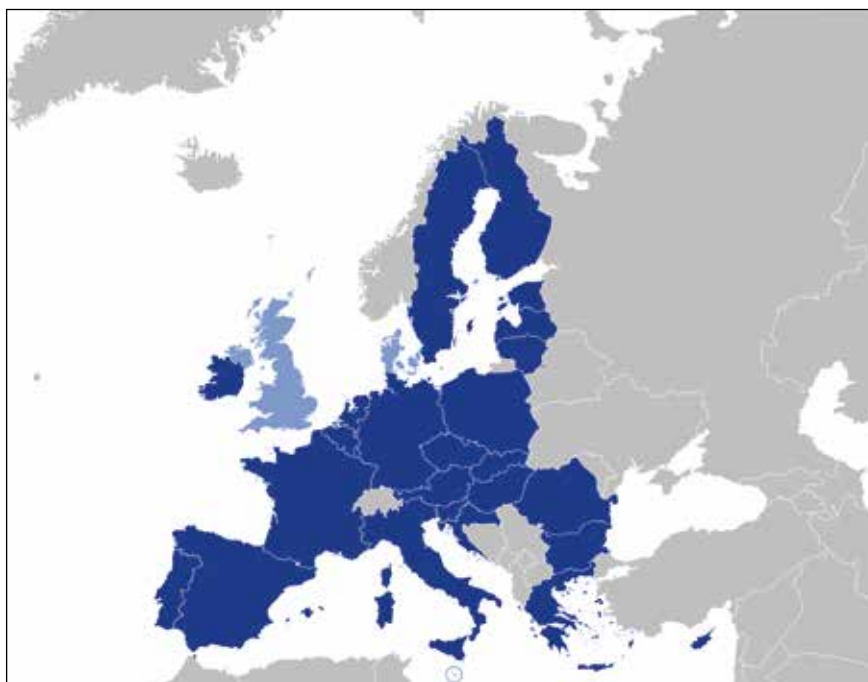
In order to further advance cooperation, the European Council included the programme among PESCO ones at the end of 2018. The Czech Republic has finally decided to join the development team through Aero Vodochody, while Belgium entered the programme with the role of observer. Moreover, the MALE RPAS will be among

the first recipients of the European Defence Industrial Development Programme, thanks to the allocation of €100M.

The operational requirements participants agreed on stemmed from the lessons learned using US- and Israel-produced systems and the willingness to fill the existing capability gap in this segment to increase strategic independence. Per these considerations, they agreed on the need of a highly capable asset able to provide 24/7, day and night Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) in wide areas and in-theatre activities. Other requirements included all weather capabilities, efficient maintenance, interoperability with existing and future defence systems, and resilience against cyberattacks. Modularity, long range of action, wide area coverage and the ability to operate short transit flights and manoeuvre at high airspeed have been identified as additional features. According to the full-sized mock-up unveiled at the ILA Berlin Air Show 2018, and also exhibited at the 2019 Paris Air Show, the MALE RPAS will be larger than General Atomics' MQ-9 REAPER. It will feature a twin-pusher propulsion and a single electro-optical/infrared (EO/IR) sensor.

Considering these features, however, the European-made MALE could represent a new missed occasion for pooling and sharing and for filling a significant capability gap among European armed forces. The offer that the selected companies presented to OCCAR in May 2019 has not convinced member states, especially France. The use of a twin-pusher propulsion rather than a single one (according to German desiderata) has an important impact on costs, which doubled from €1Bn to €2Bn for the next study phase. Even if Germany, whose contribution to the project accounts for 31%, would decide to fully fund motorisation (an unconfirmed option), the choice of the propulsion will have a negative impact on the MALE RPAS' estimated weight – about 11 tonnes compared to the REAPER's 4.5 tonnes. Worse still, the weight will negatively affect operating costs, and the system's competitiveness, thus dramatically reducing export possibilities – yet crucial for the success of the programme. All this considered, the countries involved will try to renegotiate the contract with companies to find a better balance between performances and costs. However, this process could originate a new delay in the initial schedule, as 2020 was initially identified as the year for the delivery.

Moreover, the programme could finally be the victim of political considerations. In the last months, the Italian government



Map of the members of the Permanent Structured Cooperation (PESCO); dark blue: PESCO member, light blue: other EU member

declared that it could finally resume the purchase of 20 Piaggio P.2HH UAVs, initially blocked due to budget constraints, to save the company from bankruptcy. Indeed, such a move could put the Italian participation in MALE RPAS at risk, as the country cannot afford to participate in several big programmes at the same time with its current level of defence expenditures. Similarly, Spanish participation could be finally questioned, as the country has purchased two MQ-9 REAPER last April and is also evaluating the possibility to procure US-produced fighters.

The Lack of an “EU Defence Mindset”

Recent efforts to establish a real EU defence have been warmly welcomed by stakeholders and experts – at least at the beginning. Indeed, the degree of cooperation that member states have been able to reach in only a couple of years is remarkable compared to previous attempts. Most interestingly, the efforts begun in the aftermath of the Brexit referendum seemed driven by the quest of a coherent strategy and synergy among stakeholders. Before 2016, EU member states focused on the most politically shared actions rather than advancing according to a specific strategy aimed at achieving given objectives and priorities. The legal and political measures taken in the past finally suffered from the lack of enduring political willingness and of a coherent strategy. The fact that the bot-

tom-up approach has been preferred to the top-down one created further fragmentation over time, and downsized the real impact of joint defence policies and programmes.

In the pathway that followed, the Commission has taken the lead of joint efforts involving states (via the Council), EU people representatives (via the EU Parliament), EDA and EU defence industries. However, this embryonic form of strategic thinking, which could have finally been a game changer for EU defence cooperation, is already demonstrating its weaknesses. In particular, the pathway identified by the Commission to enhance EU defence and ease cooperation at the EU-level will likely have opposed effects than those intended.

In particular:

- Being R&D-oriented, EU funding could finally be diverted by companies for other uses – and the Commission will be unable to mitigate the phenomenon.
- Ongoing EU initiatives, thought to enhance strategic independence from the US are somehow benefiting Washington in political and industrial terms.

Funding R&D Could Endanger EU Defence

The first phases of a defence programme have become the most expensive ones in the last decades, while life-cycle costs have been shrinking. Per this consideration, the Commission believes that helping member states to fund military R&D



Photo: ESuT

The A400M is an example of successful cooperation on defence projects.

could convince them to choose cooperation for modernising their armed forces despite budget constraints.

To further reinforce the impact of EU funds on the build-up of a common EU defence, the Commission added some specific prerequisites to become EDF's recipients. First, member states must engage themselves to buy the products developed from EU-funded R&D projects and/or prototypes. Second, the uniqueness of the product is a necessary condition to receive EU funds in an attempt to reduce the number of variants developed – the Italian and French FREMMs are one of the most notable examples.

However, these conditions could finally be incoherent with what the Commission wants to achieve, as companies and states might grab funds and later overcome EU-imposed conditions. As defence companies often struggle to obtain funding needed for R&D, usually asking states to provide them with economic support, member states will likely push national businesses to apply for EU funds. They might then commit themselves to fund the process required of the development and to procure the final product. Once the funds will be obtained, states might finally refuse to fund the remaining phases, reduce or cancel orders, and all other modifications often occurring to military procurement programmes in recent years.

Member states and national companies might thus obtain funds to finance R&D in common technologies they are interested in. Once the know-how obtained, the original programme might be sacked (as has occurred to several multilateral programme, began in pool and ended up with nation-tailored products). Such a scenario would end in the waste of EU funds, as they would neither allow to push forward new joint programmes, nor to advance EU defence cooperation. Worse still, as defence mainly remains

a national prerogative, the Commission would not be able to prevent such a phenomenon, nor to condemn states or companies in case of misuse.

Even in case of successful funding, the EDF mechanism will not solve some peculiar problems of common defence programmes, namely the duplication of production lines. Member states will likely use the “made in EU” nature of the programme as a justification to pursue their employment policies. Consequently, they will likely ask to duplicate production lines (like occurred to the Eurofighter programme), asking one for each concerned country (or equivalent compensation), thus negatively affecting efficiency and costs. This would result in common programmes, but unsustainable formulas.

The Negative Impact of Timing

The fact that funds belonging to the EDF will be allocated between 2021 and 2027 might not help member states in the modernisation of their defence equipment. The most relevant defence programmes for the next decades have been already launched in Europe, either as national programmes or in multilateral frameworks. This is the case, for instance, of the next generation fighter and of the future main battle tanks.

Worse still, the fact that the EDF will be confirmed with the approval of the next MFF is somehow beefing up US sales in Europe. Uncertainty and distrust in EU-developed programmes, usually delivered with significant delays and more expensive than off-the-shelf solutions (e.g. A400M), have finally convinced several member states to fill their capability gaps by buying US-produced systems, with at least two important consequences. First, further reducing the need to develop new European technologies. Second, such an approach undermines the efforts to use EU defence

cooperation as a tool to regain strategic independence from the US, as it is feeding up the industrial and political ties between Washington and European states – reinforcing the US narrative on European defence.

Possible Solutions

The fact that the Commission used economy-led considerations to assess which phase of military products' development it wanted to fund shows that, as usually happens in Europe, the defence industry has been considered as any other industrial sector. Despite quite common, this assumption is wrong, as the defence industry has its own, tricky functioning, influenced by the high strategic importance it has for each country. To maximise the impact of EU defence funds, the Commission could have relied more on independent military experts – rather than on member states designed ones, whose proposals would be influenced by the states they are serving! Creating a Director General (DG) for Defence, an option which is on the table, would have better supported decision-making on the EDF. The efficiency of funds could have been maximised by focusing on different phases of the production cycle. For instance, funding the acquisition process of jointly developed programmes might have allowed for more control over the respect of preconditions before granting funds. Such a method, a sort of reward for states that accepted to invest to enhance cooperation, could have finally convinced members of the convenience of pooling and sharing. Moreover, granting EU funds for acquisition could have solved the problem of third parties' participation in joint programmes, which remains a disputed issue today. As for European countries, the EU would have funded acquisition for third countries depending on the degree of economic and industrial participation in the development phase. A technique that would have somehow mirrored the one used by the US, which gives credit to countries willing to buy American-produced armaments but unable to pay for them.

The fact that the next European Commission (to take office in November) will be led by former German defence minister Ursula von der Leyen might finally bring a more comprehensive knowledge of defence, with a potential positive impact on future joint efforts.

For the time being, the development of real European defence programmes still seems far from being achievable despite the efforts made in the last years. ■

Armenia in a Shifting Security Environment

Gayane Novikova

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In the context of a broad security analysis it is necessary to bring into focus the regional geopolitical environment. It critically – and increasingly – influences developments in and around every regional state. Meanwhile, a fragile regional security per se can greatly contribute to the escalation of existing local conflicts and even transform some of them into regional ones. The global security deficit is increasing.

Armenia's geopolitical location – at the core of an area that includes the South Caucasus, Russia, Turkey, and Iran – is very challenging. A hostile US – Russia relationship, growing disagreements between the US and Turkey, a new cycle of dangerous escalation of tension between the US and Iran, some improvement in Turkish-Iranian bilateral relations and the deepening ties of both states with Russia, – all these trends directly influence and shape the trajectory of Armenian foreign and security policy. Negative and/or unexpected developments in the wider region will seriously threaten Armenia's security. To survive "a battle" between the global and regional actors it needs to demonstrate and to implement maximum flexibility and maneuverability. Armenia's strategic location contains, alongside serious limitations, also some advantages. Therefore, geopolitics matters ...again.

The "Velvet" and the "Thorns"

The Velvet Revolution of April-May 2018 was focused first and foremost on Armenia's domestic issues. On the one hand, distrust in the existing political system and the power, and corruption, as well as insufficient health care, education, and social security

Photo: Kremlin



Armenia has close relations with Russia. The previous President of Armenia Serzh Sargsyan met with Vladimir Putin several times. The current Armenian government inherited a subordinated relationship with Russia.

have negatively influenced the demographic situation and foreign investments. The combined impact of these issues upon the economic development of the country was devastating: unemployment and poverty levels, according to the World Bank's prediction, in 2018 would be as high as 18,1% and 38,2%, correspondingly.

On the other hand a widespread belief that internal stability is a main guaranty for Armenia's external security constituted strong leverage for the previous government to manipulate the society and to prevent the open expression of the anger simmering in the society.

A four-day war in April 2016 in the territory of the Republic of Artsakh (Nagorno-Karabakh Republic) accompanied by artillery attacks by Azerbaijani forces on Armenia proper, brought this myth to an end: A mostly passive and silent disagreement by the society at large with the authorities was transformed into massive non-violent actions in the Spring of 2018, which in turn resulted in a full-scale change of power.

Revising the pillars of domestic policy, the incumbent Prime-Minister, Nikol Pashinyan, has argued on many occasions that a main goal of the Velvet Revolution was the initiation and implementation of significant political and economic change. These transformations – in the medium term perspective – will place Armenia among the most politically stable and attractive for business states. He also confirmed that there will be no critical changes in the directions of Armenian foreign policy, and that Armenia will remain committed to all its international obligations. Meanwhile, his message to the international community accentuated the priority to preserve and strengthen Armenia's sovereignty and security.

The current Armenian government inherited a subordinated relationship with Russia, a very cautious and limited cooperation with the EU, a low-level cooperation with the US and NATO, and a very narrow participation in regional communication and transportation systems. A direct involvement in the Nagorniy Karabakh conflict, and therefore extremely complicated relations with Azer-

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bajian and Turkey, continuously play a part in Armenia's interactions with regional and global actors.

Three factors – the threat of becoming a target in a cyber war, a growing militarization of the broader region, and an ongoing conflict with neighboring Azerbaijan – demand from Armenia a reevaluation and modification of its national security and defense strategies. In February 2015, the Ministry of Defense amended its military doctrine shifting away from a deep defense to a preemptive deterrence approach through the adaptation of a so-called deterrence system. This significant change has required a modernization of the weapons arsenal.

"Just Business"

Russia, affected by European and American sanctions, is eager to preserve and extend its ties with the states, interested in any type of cooperation. Arms sales, together with oil and gas deliveries, have become over the years unique tools for Russia in achieving its strategic goals. Control over its neighboring states plays a significant role in Russia's strategic thinking and acting. Russia remains a major weapons supplier for Armenia and Azerbaijan. However, there are some nuances in its approach to these two states, both of which Moscow defines as its strategic partners. Azerbaijan does not participate directly in any organization under Russia's leadership and does not have a desire to do so. It purchases Russian offensive weapons at export prices. The Russian



Graphics: Via author

Armenia and Azerbaijan are hostile Caucasian nations involved in a protracted conflict.

military presence in the Azerbaijani territory ended with the closure of the Gabala Radar Station in 2012.

Armenia is a member of all Russia-led political, military, and economic organizations. One Russian military base is located on Armenian soil; the Yerevan airport near Yerevan hosts the Armenian and Russian air forces; Russian guards patrol Armenia's external borders together with their Armenian counterparts. Russia has been considered one of the main security guarantors of Armenia. As a member of the CSTO (Cooperation and Security Treaty Organization), Armenia has

been purchasing Russian defensive weapons at Russian domestic prices.

Declaring serious changes in the Armenian defense strategy, the Pashinyan government has intensified military ties with Russia, confirming all previous bilateral agreements and focusing upon the purchase of modern weapons. In August, 2018, Armenia signed a new \$100- million loan agreement with Russia, and in January 2019, the two sides signed a new contract: Eighteen new Sukhoy SU-30SM jets will replace old MiG-29 jets. Four of them will be deployed either at the end of 2019 or the beginning of 2020 at the Yerevan Air Base. The Armenian air defense system includes also Russian-made S300 and BUK-M2 surface-to-air missiles of varying range, as well as the Iskander short-range ballistic missile system.

In comparison to Armenia, Azerbaijan has more financial resources, which provide it with more options to diversify arms purchases. Although Russia remains a major arms supplier, Azerbaijan buys several types of weapons from Israel, Belarus, and Turkey. In addition to the Russian-made S300 and TOS-1A (Solntsepyok) rocket systems, Azerbaijani air defense forces are equipped with Israeli LORA ballistic missiles, Hermes-900 surveillance drones, and EL/M-2106-ATAR sky-capture advanced radars; they possess also Belarusian Polonez tactical missile complex and Turkish İHTAR anti-drone system and SOM-B1 cruise missiles.

The Armenian leadership has many times and at different levels expressed its disappointment and irritation with Russia and Belarus (which are Armenia's partners in the CSTO and the Eurasian Union) regarding their military ties with – and weapons supplies to – Azerbaijan.



Photo: Armenian Ministry of Foreign Affairs

On 24 July 2019, Armenian Foreign Minister Zohrab Mnatsakanyan met with Mamuka Bakhtadze, the Prime Minister of Georgia. They touched upon a number of issues on the Armenian-Georgian bilateral agenda and positively assessed the effective collaboration between Armenia and Georgia within international organisations.

Between the Devil and the Deep Blue Sea

Another serious security challenge for Armenia results from the Russian-Turkish cooperation in the military sphere, which is growing and deepening. Of most concern is the deployment of the Russian S400 Triumph in Turkish territory which began, in accordance with a signed in 2017 bilateral agreement, on July 12, 2019. The Russian

can analogue. This system allows Turkey to monitor, control, and defend significant territory beyond its national borders.

It should be stressed that Armenia does not have diplomatic relations with Turkey and is a party to the unresolved Nagorno Karabakh conflict with Azerbaijan – which means it has two closed international borders. In this context two issues are critical for Armenia: Where exactly will the S400 be deployed in Turkey proper, and whether

and Azerbaijan. Already in a possession of strong economic and military ties with these two neighboring states, Georgia has indicated its willingness to enhance cooperation with both states in the military sphere. In particular, on June 18, 2019, Levan Isoria, Georgia's Minister of Defense, stated at the trilateral ministerial meeting in Gabala (Azerbaijan) that his country is interested in extending regular trilateral exercises focused upon the protection of critical infrastructure, and to take part in Azerbaijani-Turkish tactical military exercises. Turkish Minister of Defense, Hulusi Akar, confirmed that the parties are planning to expand their cooperation beyond areas of defense and security. These developments demand from Armenia a strategic response aimed at avoiding any further complications in bilateral relations and at preserving Georgia as a friendly partner state. Armenia cannot allow itself either to support blindly any anti-Georgian steps taken by the Russian government, or to passively observe Azerbaijani-Turkish efforts to involve Georgia in the anti-Armenian campaign and activity.

Armenia faces another variety of complications stemming from the conflict around Iran. The withdrawn of the US from the Iran nuclear treaty in 2018, combined with the very recent highly dangerous escalation of tension in the Strait of Hormuz, in the worst-case scenario, can end in an overt international conflict. It may affect Armenia in many ways: a high probability exists that a flow of refugees from Iran to Armenia would appear; the Armenian-Iranian border would close; and a reduction of Iranian gas supply to Armenia would occur. Moreover, Armenia which has special economic, political, and cultural relations with Iran, can find itself under strong pressure – and even the threat of sanctions – from the US. It is important to acknowledge that all parties which are directly and indirectly involved and can be strongly affected by this conflict, understand the far-reaching consequences of a new war and take certain preemptive steps. In particular, according to Bloomberg (May 31, 2019), in order to avoid further military escalation in the Middle East Russia rejected a request of the Iranian government to buy the S400 missile defense system.

Concluding Remarks

An intensive militarization of the South Caucasus and a rapidly growing security deficit in the broader Middle East is forcing Armenia to reevaluate and, to some degree, remodel its security strategy.

- It is obvious that no alternative to a strong strategic partnership with Russia exists and Armenia will continue

Photo: Tankasari



Russian MiG-29 RF-93752 aircraft at Erebuni Military Base in Armenia

missiles were delivered to the Mürted Air Base in Ankara province. According to Turkish authorities, it has not yet been decided where exactly these complexes will be deployed. However, the same day Andrey Frolov, the editor-in-chief of the Russian journal "Arms Export" (Export vooruzheniy) and an expert at the Centre for Analysis of Strategies and Technologies, quoting unnamed Turkish sources, mentioned as their possible locations the Mürted Air Base and some area (as yet not identified) in proximity to the Armenian border. Earlier even rumors circulated that Turkey can deploy the Russian missile complex either in the territory of Azerbaijan or Kuwait to avoid a conflict with the US that could lead – and in fact already has led – to an exclusion of Turkey from the American F-35 fighter jet program.

Without discussing the details of this Russian-Turkish deal, which to some extent jeopardizes Turkey-NATO relationships and puts Turkish-American relations at a serious risk, it is necessary to mention that the S400 parameters (i.e. a target flights altitude 27.3 km, an anti-aircraft range 400.7 km, a radar detection range of 600.3 km, and a ballistic missile range of 59.5 km) possess real advantages over the American MIM-104 Patriot missile defense system (19.3; 69.2; 149.7, and 19.3 km, respectively). As The Wall Street Journal correctly pointed out, the S400 has not been tested in battle; however, on the paper it outperforms its Ameri-

its programming system will allow using it against the Russian Sukhoi SU-30SM fighter jets, which are in the Armenian arsenal?

At the beginning of May, 2019, the armed forces of Azerbaijan and Turkey conducted three-day joint exercises around Baku. One month later another joint short-term exercise took place in the Azerbaijani exclave of Nakhchivan, on the border with Armenia. In mid-June 2019, the Armenian Armed Forces evaluating the country's air defense capacities, conducted military exercises with the inclusion, among others, of the S300 missile defense system.

Georgia and Iran: In Trouble

Two other direct neighbors of Armenia – Georgia and Iran – which are of a strategic importance for Armenia, are facing serious problems owing to the increasing pressure from Russia and the US, respectively.

The scale of the most recent anti-Russia demonstrations in Tbilisi, which were followed by the arrest of several oppositional figures, blamed for an attempted coup-d'état, indicates once again that the existing conflict within the Georgian society between pro- and anti-Russian forces can be easily transformed into a tit-for-tat game between Russia and Georgia. In search of protection from Russia, Georgia leans toward the US and NATO as non-regional partners and – on the regional level – toward Turkey

its membership in all Russia-led international organizations, above all in the CSTO and the Eurasian Union. However, in the light of the broad spectrum of special relationships of other members of these organizations with Azerbaijan, Armenia should make it clear that its security, as well as the security of the Republic of Artsakh, is non-negotiable and it constitutes a high priority for both the Armenian government and the Armenian society.

- Armenia needs to be more involved in those NATO's partnership programs which don't conflict with its obligations to the CSTO and its bilateral military agreements with Russia.
- It should take advantage of the high interest of the European states toward the new Armenia and use this momentum to stimulate and implement programs aimed at democratization of the state and society.
- The Armenian-American relationship has high potential, which still needs to be explored.
- There is no sign of any improvement in Armenian-Turkish relations; however, it cannot be excluded that Russia will try to initiate and mediate low-level bilateral talks.
- Armenia should avoid any tension with Georgia and remain neutral in the Russian-Georgian conflict. This will allow, to some extent, to slow down Georgia's slipping into the Turkish-Azerbaijani sphere of influence. A more pro-active and multilayered policy toward Georgia will be beneficial for Armenia.
- Armenia cannot compromise and put in danger its special relationship with Iran,



Photo: US Army

Trainers from the US Army Security Assistance Training Management Organisation (USASATMO) provide instruction to Armenian soldiers during a Warrior Leader Course conducted in Yerevan, Armenia. The US has been trying to reduce Armenia's and Azerbaijan's dependence upon Russia.

a country of a strategic importance to Armenia.

- An interesting nuance is related to an attempt by the US military circles to obtain a share in the arms race in the South Caucasus. An offer from the US National Security Advisor John Bolton, made in November 2018, to sell arms to Armenia and Azerbaijan in order to reduce their dependence upon Russia still remains unanswered. Each state has its own reasons to continue to keep silent. However, on July 12, 2019, the US House of Representatives passed an amendment that prohibits the transfer of US weapons to Azerbaijan unless the President certifies that such weapons

will pose no threat to civil aviation. This initiative is an answer to Azerbaijan's standing threat to shoot down civilian aircraft operating out of Artsakh's Stepanakert Airport, that as a consequence, remains closed.

All these shifts in the security environment require from the Republic of Armenia also a serious revision of its approach to the resolution of the Nagorniy Karabakh conflict. A statement by David Tonoyan, Minister of Defense of Armenia, can be viewed as the first indication of upcoming changes. **On March 29, 2019, at a meeting with the representatives of the Armenian Diaspora in New York, he warned Azerbaijan: "...the formula 'territories for peace' will no longer exist, and we will reformulate it as 'new war – new territories.'"** This preemptive deterrence approach does not mean that Armenia will withdraw itself from the negotiations; rather, it indicates the seriousness of its intention to re-include the Republic of Artsakh into the negotiations and to provide full-scale security to both of the Armenian state entities.

Therefore, growing political-military tensions in the broad region make peace in the South Caucasus even more fragile. However, in the best-case scenario, an established internal stability will allow Armenia to increase its strategic importance and become a stabilizing factor in the region. International economic support in the form of grants and significant investments in the Armenian economy, will also indirectly contribute to regional security. Conversely, in the worst-case scenario Armenia will be trapped in regional warfare. ■



Photo: Armenian Ministry of Foreign Affairs

On 24 June 2019, Foreign Minister Zohrab Mnatsakanyan met with Michelle Bachelet, the United Nations High Commissioner for Human Rights, in Geneva, where they discussed ongoing reforms of the judicial system in Armenia.

US Army Spending Priorities in the Era of Renewed Great Power Competition

Sidney E. Dean

On 2 August 2019, President Donald Trump signed the Bipartisan Budget Act of 2019 into law. The bill provides the US government budget – for both domestic and national security spending – for fiscal years 2020 and 2021. This provides a modicum of stability, and ensures that budget proceedings will not be held hostage during the 2020 congressional and presidential elections.

The bill also lifts the mandatory budget caps for all spending categories. For fiscal year (FY) 2020 the Budget Act appropriates US\$738Bn for defence; adjusted for inflation, this represents a real growth of approximately 1% over the 2019 spending level. For FY2021, the bill allocates €740.5Bn in defence spending.

The bill specifies allocation of funds to the major budget categories. For the US Army the rounded figures (including Active Component, Reserves and National Guard) are:

- Personnel expenses: US\$55.8Bn, the largest single budget category;
- Operations and Maintenance: US\$51.8Bn;
- Procurement: US\$22Bn;
- Research, Development, Test and Evaluation (RDTE): US\$12Bn.

The budget is rounded out by smaller allocations to such categories as construction, housing, base realignment and closure, and chemical weapons destruction. Support for training and equipment missions in the Middle East and Afghanistan is estimated at US\$5.8Bn for FY 2020.

- The Army procurement budget for FY2020 breaks down into the major subcategories of:
- Aircraft – US\$3.7Bn;
- Missile Systems – US\$3.2Bn;
- Weapons and Tracked Combat Vehicles – US\$4.8Bn;
- Ammunition – US\$2.6Bn;
- Other Procurement (including non-tracked vehicles as well as communications and electronic equipment) – US\$7.6Bn.

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Photo: Sikorsky



The Sikorsky-Boeing DEFiant helicopter design is a contender for the Army's Future Vertical Lift programme.

The RDTE budget breaks down into the major subcategories:

- Basic Research – US\$455M;
- Applied Research – US\$894M;
- Advanced Technology Development – US\$1.1Bn;
- Demonstration and Validation – US\$2.9Bn;
- Engineering Manufacturing Support – US\$3.5Bn;
- Testing and Management Support – US\$1.3Bn;
- Operational System Development – US\$1.98Bn.

Precise allocation of the money to individual programmes is yet to be determined, presumably in September when Congress returns from recess. However, the Pentagon's original budget request for 2020, as well as numerous formal statements by Army leaders and in planning documents, clearly define the service's priorities.

Balancing Operations

The original FY2020 budget request submitted by the Army in March 2019 emphasises the dual goals of enhancing current readiness while simultaneously modernising the force in order to prevail in future conflicts. "The FY2020 budget is a major milestone in the Army's implementation of the NDS [National Defence Strategy] and recovery from depleted levels of readiness brought about by nearly 18 years of sustained conflict and 9 years of constrained budgets. Our adversaries capitalised on this period of strategic atrophy by modernising their militaries and closing the overmatch we held for decades. Guided by the NDS, the FY2020 budget places the Army on a clear path to remain ready, modernise and increase the Army's lethality to stay ahead of its competitors both now and well into the

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Photo: US Army

The latest variant of the legacy AH-64 APACHE attack helicopter family is currently being acquired through remanufacture of 634 AH-64D variant airframes and 56 new build airframes for a total of 690 AH-64E aircraft.

future. The first priority is readiness and this budget puts us on track to reach the required NDS readiness level by FY2022. The next priority is modernisation and this budget positions the Army to reach the NDS driven modernisation goals by 2028.” [Office of the Defence Undersecretary (Comptroller), Defence Budget Overview, March 2019, p. 9-2]

To support these goals, senior generals in late 2018/early 2019 conducted an in-depth review of current spending, with an eye to programmes that could be cancelled, reduced or delayed in order to free up funding for higher priority programmes. As a result, over a five-year period the Army proposes to cut US\$31.5Bn in previously planned spending on nearly 200 current programmes, and transfer that money to projects with a more immediate impact on readiness and modernisation. The FY2020 portion of that figure amounts to US\$3.6Bn. Whether all of the recommended cuts will be approved by Congress remains to be seen, but the aggregate impact of this decision will fuel the modernisation and reform process.

The Big Six Priorities

The modernisation strategy is primarily geared toward adversaries with sophisticated capabilities, both at the conventional level and at the asymmetric level, including cyberwarfare and space operations. While medium-scale or regional powers such as Iran and North Korea have been systematically enhancing their military capabilities – both through domestic development and through imports – the NDS has squarely returned the Pentagon’s focus to preparing for the eventuality of a peer-level conflict against either Russia or China.

Overall, the Army plans to invest US\$57Bn in modernisation over the next five years (74% more than anticipated in prior five-year plans), with the pace of investment and development set to increase significantly as of FY2021. Beginning that year, RDA (Research, Development and Acquisition) accounts for the modernisation priorities will exceed the investments for comparable legacy programmes, according to Army Comptroller Lt. General James Pasquarette. Army Undersecretary Ryan McCarthy gave a more cautious assessment in May, citing 2024 as the year in which investments in developmental systems and legacy systems draw even; for reference, at the end of FY2017 the development vs. legacy ratio was 80:20.

The Army’s technology modernisation plans focus on 31 distinct initiatives (a portion of which are concept development projects rather than full-fledged programmes of record) organised into six cat-

egories. These “Big Six” categories receive 80% of the RDTE budget allocation. These categories are (in order of importance):

Long-Range Precision Fires (LRPF)

Over the 2020-2024 timeframe, the Army plans to invest US\$5.7Bn in long-range tube, rocket and missile artillery programmes. At the lower end of the spectrum, LRFP seeks to extend the effective range of 155mm howitzers from the current 30 kilometres to at least 70 kilometres by 2023 through modification of the artillery with longer barrels as well as through development of longer range precision munitions (Extended Range Cannon Artillery – ERCA). The prototype of the Precision Strike Missile PSM is expected to be tested in 2023; the missile’s target range of 496 kilometres will likely be significantly extended now that the Intermediate Nuclear Forces Treaty is defunct. At the extreme end of the spectrum the Army seeks to develop a Strategic Long-Range Cannon capable of firing rocket-propelled projectiles to a distance of 1,800 kilometres, and a hypersonic missile with an objective range in excess of 2,200 kilometres. The hypersonic weapon is being developed in coordination with the Air Force and Navy, with each service proving elements of the system (in the Army’s case, the hypersonic glide body), and individually configuring the weapon to their own needs. The Army plans to stand up a testing battery with four missile carriers and eight hypersonic missiles by 2023, accord-

Photo: US Army



Under Secretary of the Army Ryan D. McCarthy discusses newly activated Army Futures Command during a roundtable held at the command’s headquarters in Austin, Texas, 24 August 2018. The Army Futures Command’s mission is to develop how future Army organisations will fight with new technology and ensure rapid delivery of war fighting capabilities.

ing to the Programme Executive Officer, Lt. General Niel Thurgood. LRFP is given top priority among the modernisation categories because analyses show that, in the early weeks of a conflict against a peer-competitor, the US is unlikely to enjoy air dominance; instead, the Army will carry the initial burden of degrading enemy air defence, missile forces, and staging areas.

Next-Generation Combat Vehicle (NGCV)

The five-year spending plan for future armoured combat systems is valued at US\$13.2Bn. NGCV is likely to encompass a family of vehicles designed to ultimately replace the current Bradley infantry fighting vehicles (IFV) and, in the long term, the Abrams main battle tank (MBT). Manned, optionally manned, and unmanned systems are being considered under the NGCV category. The coming five years will see testing, prototype redesign, and additional testing for the BRADLEY successor vehicle (the Optionally Manned Fighting Vehicle or OMFV), as well as the Mobile Protected Firepower (MPF) combat support vehicle and some robotic vehicles. The FY2020 budget provides US\$378M for OMFV and US\$310M for MPF in that year alone. Initial Operational Capability (IOC) for both manned systems is expected for 2026 and 2025, respectively. Testing of light and medium robotic combat systems to support the manned armoured vehicles is scheduled to begin in 2020, with testing of a heavy robotic vehicle to follow.

Future Vertical Lift (FVL)

FVL is slated to receive US\$4.7Bn over the next five years. The programme seeks to develop and acquire a family of five next-generation aircraft to replace current combat and utility helicopters. The Army is currently pursuing simultaneous development of the two medium-sized FVL types, the Future Long-Range Assault Aircraft (FLRAA) and the Future Attack Reconnaissance Aircraft (FARA). Extra funding added over previous planning should enable an accelerated design and testing stage, leading to earlier than planned fielding. FLRAA is now intended to enter service circa 2030 and replace the UH-60 as a troop carrier. FARA is needed to fill the gap left by the retirement of the OH-58 KIOWA WARRIOR armed reconnaissance helicopter, but is also slated to replace circa half of the 700 AH-64 APACHE attack helicopters in the current fleet. The Army hopes to accelerate FARA initial operational capability from the current target of 2028. Various tech-



Photo: US Army

A 5 kW laser integrated on a STRYKER participated in the Manoeuvre Fires Integrated Experiment (MFIx) at Fort Sill, 5 April 2017. The Army is now accelerating the rapid prototyping and fielding of 50 kW-class lasers on a platoon of STRYKERS.



Photo: Raytheon

Raytheon is developing DEEPSTRIKE to meet the US Army's Precision Strike Missile requirement.

nologies are being considered for both systems, including conventional helicopters, helicopters with coaxial rotor technology, and tiltrotors.

Mobile Network

Development of the new mobile command, control, communications and intelligence network is slated to cost US\$12.5Bn over the next five years. It will encompass a joint battle command platform to provide tactical situational awareness from the brigade to the platoon level, as well as portable communications and data devices, including commercial-off-the-shelf

hardware equipped with military-specific applications.

Air and Missile Defense (AMD)

New AMD systems (including weapons and sensors) capable of defending against sophisticated enemy weapons including stealth aircraft, highly manoeuvrable cruise and ballistic missiles, and hypervelocity projectiles will require US\$8.8Bn for development over the next five years. Technologies being pursued include traditional air defence missiles as well as high-powered lasers and microwave weapons, the lat-

PHOTO: US Army



To enhance operational capability and adapt to new threats, the Pentagon plans to combine EW assets along with cyber and information operations capabilities across all echelons of the Army.

ter primarily intended to counter UAVs. FY2020 appropriations include US\$243M for integration and testing of the Indirect Fire Protection Capability Block 1, designed to defeat cruise missiles, UAVs, and shorter range rocket, artillery and mortar threats. Another major AMD focus is the Lower Tier Air and Missile Defence Sensor, a gallium-nitride based Radar intended to improve range and accuracy of the Patriot AMD system. The FY2020 budget provides US\$418M to initiate prototype manufacturing and integration.

Soldier Lethality

The Soldier Lethality category mostly encompasses offensive and force-multiplier infantry equipment. Development costs are estimated at US\$6.7Bn for the 2020-2024 timeframe.

Observers frequently note that LRFP and FLV – which the Army explicitly categorises as the first- and third most important modernisation accounts – receive the least funding of the “Big Six”. Undersecretary McCarthy explains that some research

Photo: US Army



The Soldier Lethality modernisation category encompasses more than weapons; the quantity and capabilities of Soldier-wearable technologies are expected to increase significantly, as will the need for power and energy sources to operate them.

and development programmes are simply more expensive than others. This is largely dictated by the different state of readiness of the various technologies. Initial research and development is generally cheaper than experimentation and prototyping (which itself is less costly than entering Low Rate of Production or LRIP). For example, while development of new howitzer ammunition and range-extending barrels is progressing well, the more ambitious elements of the LRFP category are largely in the concept development stage, which reduces short-term budgetary pressure on the LRFP category as a whole. By contrast, other categories such as NGCV or AMD are – at least in part – examining systems with currently available prototypes or concept demonstrators, while several AMD projects are repurposing currently operational technology for new uses.

Readiness Enhancement

Despite the high-profile modernisation programs, readiness remains the number one priority according to General Mark Milley, the new Chairman of the Joint Chiefs of Staff. During an interview given in April while still Army Chief of Staff, Milley stated that the service has already made significant improvements since 2015. “I think we were on a downward slope of readiness relative to the tasks required to be able to fight near-peer competitors,” Milley said. “Our readiness was probably okay for counterinsurgency and counterterrorism but not for the higher end of warfare. At that time, we really only had two or three brigades at the highest levels of readiness; today we’re in excess of 20.” In August, Ryan McCarthy boosted the assessment to 25 ready brigades. While the Army’s objective is to maintain 66% of active component brigades and 33% of Reserve and National Guard brigades at the highest readiness level, the current readiness level stands at approximately 40% across the board. The Army expects to meet the objective readiness level by 2022 or 2023. To this end, the FY2020 budget request allocated 53% of the active duty operations and maintenance fund to Land Force Readiness and Land Force Readiness Support activities. For the Army Reserve and National Guard, the corresponding figure is circa 80%.

Legacy Upgrades

One aspect of enhancing readiness is upgrading the capabilities of weapon systems currently in the inventory, or procuring advanced variants of such legacy

systems, until next generation systems become available. Just for FY2020 the Army requested US\$1.75Bn to upgrade the Abrams MBT to the M1A2C configuration which features an improved power system, survivability enhancements, and a reduced maintenance requirement. A fourth variant upgrade, the M1A2D featuring enhanced lethality through addition of a 3rd generation FLIR, is still under consideration for implementation in the next few years.

Other legacy system upgrades featured in the Army's FY 2020 budget request include:

- US\$639M for M2A2 BRADLEY IFV upgrades and modifications;
- US\$807M for remanufacture of AH-64D APACHE attack helicopters to the AH-64E configuration;
- US\$737M for the purchase of 147 Patriot MSE (Missile Segment Enhancement) AMD missiles and 40 launcher modification kits (plus auxiliary equipment);
- US\$387M for upgrades to MLRS (Multiple Launch Rocket System) artillery carriers;
- US\$341M to upgrade and extend the service life of legacy ATACMS tactical missiles (range: 300 kilometres)

In addition, some new systems have recently entered service and are in Low-Rate or Full-Rate of Production (LRIP/FRIP), while some legacy systems continue to be produced and procured. The FY2020 request for procurement includes:

- US\$996M for procurement of 2,530 Joint Light Tactical Vehicles (long term acquisition of the JLTV has been reduced by 1,900 vehicles through 2028 on the premise that the vehicle is too vulnerable for frontline operations against a peer opponent);
- US\$1.1Bn for the purchase of 73 UH-60 BLACK HAWK utility helicopters;
- US\$550M for procurement of the latest Stryker combat vehicle variant, which features both survivability and lethality upgrades;
- US\$553M for procurement of the latest variant of the PALADIN 155mm Self-Propelled Howitzer.

Force Structure

In addition to new technology and additional hardware, the Army is reorganising the force structure to enhance readiness and lethality. This includes embedding greater combat support capability into field units. Examples cited in spring by Undersecretary McCarthy include standing up additional air defence and MLRS (Multiple Launch Rocket System) long

range rocket artillery batteries. The air defence portfolio in turn consists of several elements, including the STRYKER IM-SHORAD (InterMediate SHORt Range Air Defence) system which fills a pressing capabilities gap, especially with units forward deployed in the European theatre. SHORAD alone is being budgeted at US\$262M for FY2020. This will procure 44 operational STRYKER air defence vehicles, and is double what previous Army planning had allocated to SHORAD for

the inclusion of broad spectrum offensive EW capabilities) is expected in the 2022-2023 timeframe.

A further readiness-enhancing goal is staffing brigade combat teams at 105% of their formal authorisation; this aims to ensure deployment at full strength despite the inevitable temporary loss of personnel due to illness or injury. For FY2020 the Army budget request called for a modest increase of 2,000 active duty personnel authorisations, for an active duty strength



Photo: Rheinmetall

Germany's Rheinmetall has partnered with Raytheon to offer the KF41 LYNX armoured fighting vehicle for the Army's OMFV competition.

the two-year period 2020-2021. Through 2024 the Army seeks to acquire 144 STRYKER SHORAD systems, enough to equip four complete batteries. The first battery is scheduled to deploy to Europe by the end of 2020.

Enhanced offensive electronic warfare (EW) capabilities, which are to be integrated in brigade combat teams, are also being developed. While not included in the "Big Six" modernisation categories, offensive EW is considered a vital force multiplier, especially in scenarios involving Russia which itself fields highly sophisticated EW capabilities. The Army has currently budgeted US\$3.4Bn for development of tactical EW systems (which will include signals intelligence and a basic cyber warfare capability) over the 2020-2024 timeframe. Lt. General James Pasquarrette, Army Deputy Chief of Staff for Resources, indicated during a conference in June that additional funding might be forthcoming beginning with the FY2021 budget. IOC for the vehicle based EW system (dubbed Terrestrial Layer Intelligence System or TLIS, despite

of 480,000 soldiers. The Army's ultimate objective is an end-strength of just over 500,000 for the active duty force and a comparable increase for the reserve components. Neither the current budget nor the current recruiting environment are conducive the meeting the expansion goals, with even the Pentagon conceding that the objective force level cannot be met by 2024 as originally anticipated. While the Army is currently struggling to maintain its overall manpower level (and the budget act fails to appropriate the full US\$60.4Bn personnel funding requested by the Pentagon), the service plans to prioritise manning of combat units by reducing administrative positions. In this context the Army also has implemented the "deploy or get out" programme requiring all personnel – whether serving in combat or support roles – to be fit for deployment to conflict zones. Additional funding for training is also provided for, increasing entry-level infantry training from 14 to 22 weeks, and significantly expanding brigade level exercises at combat training centres, as well as multilateral exercises in Europe and Asia. ■

The Crucible of Conflict

Lessons from 20 Years of Combat in the Middle East

John Antal

The Middle East, according to renowned Professor J. Rufus Fears, “is the crucible of conflict and the graveyard of empires.” It is the crucible of conflict because almost all great powers have fought there since the beginning of recorded history.

It is the graveyard of empires as the Middle East has swallowed up armies and resources since before the time of Ancient Rome. In the past 20 years, the US and NATO have poured their blood, energy, and treasure into trying to solve impossible problems in the Middle East and Afghanistan. The result has been casualties, disruption, a wave of refugee immigration smashing against the shores of Europe and more, not less, instability in the Middle East. The strategic, operational, and tactical lessons learned are legion. Let us look at nine lessons from the past two decades of conflict in the Middle East and Afghanistan as seen through the eyes of the enemy, Russia and the US, including NATO.

Enemy Lessons

You learn everything from the enemy. In his novel *Ender's Game*, a book on the US Marine Corps Commandant's reading list, Orson Scott Card stated: “There is no teacher but the enemy. No one but the enemy will tell you what the enemy is going to do. No one but the enemy will ever teach you how to destroy and conquer. Only the enemy shows you where you are weak. Only the enemy tells you where he is strong. And the rules of the game are what you can do to him and what you can stop him from doing to you.” In the past twenty years, the Iraqi Army, the Taliban, al-Qaeda, the Islamic State of Iraq and the Levant (ISIL, also known

the foundation of modern society, it is also the lifeblood of insurgencies and terrorists. Some recent examples of technologies turned into instruments of war: the exploitation by Al Qaeda and ISIS of social media; the use of cell phones to set off improvised explosives (IEDs); and the employment of weaponised, commercial explosive drones against the Aramco oil pipeline in Saudi Arabia. The most effective terrorist and insurgent groups today have much in common with tech start-up companies; they take COTS equipment and modify it to fit their combative needs. Operations in cyberspace allows groups to organise, recruit, train, conduct reconnaissance, plan and execute missions, fund and propagandise. The Internet is cheap, ubiquitous and accessible, and offers every jihadi and guerrilla group a worldwide capability. The Internet and COTS equipment, however, have vulnerabilities that the US and NATO can use to their advantage. The lesson, therefore, is that any new technology that can be weaponised, will be weaponised by insurgents and terrorists. This should continue to be an area of primary focus by the US and its allies.

Tactics

Insurgents and terrorists use the classic tactics of a smaller force, avoiding direct engagement, and employing their limited resources in surprise attacks. The most effective of these attacks have a direct political aim such as the assassination of critical leaders or the attempt to shift allegiances by causing mass casualties. One example is the case of Ahmad Shah Massoud, known as “Lion of Panjshir,” who fought both the Soviets and the Taliban. He was described by author Robert D. Kaplan as one of the greatest guerrilla leaders of the 20th century. Just after he warned the US that Al Qaeda was planning a major attack on US soil, Massoud was killed by an Al Qaeda suicide bomber who detonated a powerful explosive charge concealed in a video camera. In one fell swoop, Al Qaeda and the Taliban eliminated their most potent rival and

Photo: US Army



The US-led coalition against ISIS is composed of personnel from over 30 countries. In this photo, Iraqi soldiers practice marksmanship with assault rifles at Al Taqaddum, Iraq, 3 July 2019.

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as ISIS), Iran, and others have opposed US and NATO in the Middle East and Afghanistan. Learning lessons from these adversaries is important. Here are three:

Technology

Weaponising cheap, Commercial Off-The-Shelf (COTS) technology is the method of choice for terrorists and insurgents to develop a high-tech arsenal. If technology is

possibly the future leader of Afghanistan. Two days later, the 9/11 attacks on the US occurred, plunging America and her allies into war against Al Qaeda, the Taliban, and eventually Iraq. It is an exercise in counterfactual history to guess how 9/11 might have been averted and the war could have turned out differently if Massoud had lived to lead the effort against Al Qaeda and the Taliban. Leadership matters, and the lesson learned is that key leaders are primary targets of an insurgent or terrorist enemy and must be protected.

Strategy

The recent destruction of the ISIS Caliphate in Syria and Iraq in March 2019 was a stunning defeat for the terrorist group. The territory ISIS once controlled now lays in ruin, but this is only the end of a phase for a terrorist movement that is based on an idea (Salafi-jihadist supremacy) versus a location. The strength of western military forces is that they can destroy conventional armies, smash infrastructure, control territory and contain populations, but they are not equally capable in destroying an idea. The geographical Caliphate is gone, and ISIS is down, but not out. According to Hassan Hassan of the Middle East Institute, Washington DC, ISIS is reorganising in the "borderlands where both the Iraqi and Syrian governments have more limited reach... ISIL has a strategy to resume its insurgency after the collapse of its government, namely from rural areas... to conduct hit-and run operations...in the next phase of insurgency." Conserving their forces, and working hard to avoid a tempting target for US and Russian precision weaponry, "they are most likely to melt back into the population by virtue of their anonymity, expertise, and mobility." Hassan goes on to say that to counter ISIS, the US-led coalition should "anticipate jihadi strategies and pursue actions founded upon a long-term and clear guiding policy." In short, ISIS is reforming and their new caliphate will be virtual in this new phase. Unless the ideology of ISIS is discredited and defeated, countering the re-emergence of ISIS will require a focused and long-term counter-terrorism (CT) effort against an enemy who will seek to transcend borders and domains.

Russian Lessons

The Russians intervened in the Syrian Civil War in 2015 and are still engaged in support and combat operations in Syria. The Russian military has learned many lessons from their time in Syria and is applying this knowledge to how they expect to fight future wars. This includes:

Russian Technology

The Russians have used their operations in Syria to train their forces and test a new suite of weapons from unmanned URAN-9 robotic combat vehicles to Su-33 fighters flying from the deck of the Russian aircraft carrier Admiral Kuznetsov. One ground combat lesson that stands out is the value of light truck formations in fighting in areas of open terrain with low troop densities. As ISIS surged in Iraq and Syria in 2014, they generated a "motorised" force primarily based on brand new Toyota Hilux pick-up trucks. These trucks were turned into "technicals", armed with heavy machine guns, automatic cannons, and even rocket launchers. ISIS used these motorised forces to swarm over the desert, and in several successful operations, such as the fighting for Fallujah and Mosul in 2014, used mobility to swiftly outflank and overwhelm



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US paratroopers assigned to the 3rd Brigade Combat Team, 82nd Airborne Division, secure a helicopter landing zone on 20 July 2019, in Kandahar Province, Afghanistan.



In September 2015, Russia intervened in the Syrian Civil War. Depicted here, the Russian military is unloading an S-400 air defence system at the Khmeimim Air Base, near the port city of Latakia, Syria.

the defenders. Ironically, most of these trucks were purchased by the US State Department and the UK as non-lethal aid and subsequently captured by ISIS. Nonetheless, the low-cost, mobility, versatility, and sustainability of these commercial truck mounted forces impressed the Russians and they developed their own “technicals” in Syria. The Russian Army took this lesson to heart and created a force equipped with the Russian-made, gas-powered, UAZ 3163 PATRIOT pickup trucks as part of the 30th Separate Motorised Brigade of the 2d Guards Army in the Central Military District of Russia. This force allows Russia to rapidly deploy a very light, yet mobile force, with significant fire-power, for their near-abroad or expeditionary operations in the Middle East. In 2016, the Russian news outlet *Isvestiya* reported: “These battalions are being developed from the experience of combat actions in Syria. In a day, the typical motorised rifle battalion equipped with armoured personnel carriers or infantry fighting vehicles can complete a march of not more than 100 km. But an MRB (motorised rifle battalion) in the UAZ Patriot can go several hundred kilometres in a day. Moreover, acting in small groups, motorised rifle platoons and companies in pickups can slip through enemy forces and deliver quick strikes.”

Russian Tactics

Operations in Syria also demonstrated the advances in Russian aviation since the 2008 Georgian War. In operations in Georgia, Russian deficiencies in aircraft and pilot training became painfully clear. Since then, the Russian Air Force has dramatically improved. Most importantly, the Russians have sharpened their ability to launch precision strikes. Roger McDermott of the *Eurasia Daily Monitor* in a July 23, 2019 article reported that the Russians improved their precision strike capability: “the use of VKS Long-Range Aviation—particularly the Tu-160, Tu-22M3 and Tu-95MS bombers using air-launched cruise missiles against Islamic State targets...were used to launch cruise missiles for the first time in Russian military operations — air and sea-based assets were deployed in this effort”. While this marked Russia’s entry into the high-precision strike regime and the practical experimentation with network-centric approaches to warfare, the author admits most Russian ordinance dropped in Syria was free-falling. Long-range precision strike is one of Russia’s top military priorities. In 1999, Russian Major General Vladimir Slipchenko, in his work *Future War*, classified warfare into six categories and stated “that

sixth-generation wars would be denoted by offensive aerospace operations, led by UAVs preceded by electronic warfare (EW) operations, and only a supporting role for ground forces.” Since then, the Russians have worked to increase the range, lethality, and accuracy of their long range, precision strike forces, and have deployed systems such as the 9K720 ISKANDER-M ballistic missile (NATO designation SS-26 STONE) and 9M728 ISKANDER-K cruise missile systems.

Russian Strategy

In 2011, Russia abstained from the UN vote that was used to authorise NATO’s operations against Libya. After rebels killed Muammar Al Gaddafi on October 20, 2011 and toppled the regime, Libya devolved into chaos. By 2016, President Barak Obama admitted that this was the worst mistake of his time in office. The fate of this former Soviet/Russian ally caused Russia and Vladimir Putin to silently pledge not to abandon allies again. As a result, when the Syrian Civil War erupted in 2011, Russia decided to support its long-time ally, Bashar al-Assad, and deployed forces in 2015. Working and cooperating with allies such as Hezbollah, Syria, and Iranian forces in Syria, the Russians continue to learn lessons on how to cooperate with military forces from other cultures with different capabilities. Most importantly, through its actions in Syria, Russia as deployed capabilities to fundamentally change the military and political landscape of the Middle East.

US and NATO Lessons

The US and NATO members have been involved in the Middle East since the start of the Alliance, but the lessons of the past two decades, purchased in blood, have dramatically changed the way US and NATO countries think about future wars. A few of the major lessons learned are as follows:

Technology

One key lesson was the development of vehicles to defeat Improvised Explosive Devices (IEDs). Rather than deploy the appropriate number of existing armoured vehicles to meet the threat, the decision was made to armour-up existing High Mobility, Multipurpose, Wheeled Vehicles (HMMWVs), create specialised Mine Resistant, Ambush Protected (MRAP) vehicles, and develop IED jammers. A tremendous effort was energised that, over a decade, rapidly created a fleet of over 20,000 MRAPs of all types at great expense. The combination of armour

and IED jammers was largely effective, but after a decade of use, most of these MRAPs have either been chopped up, abandoned, or sold. Very few MRAPs were retained in the force can be used by the US military. The second and third order effects of this nearly US\$50Bn effort have necessitated that the US Army and United States Marine Corps continue to operate a fleet of legacy armoured vehicles including the M1 ABRAMS Tank and the M2 BRADLEY Fighting Vehicle that, although upgraded, were designed in the 1970s.

Tactics

The US and NATO learned many tactical lessons from fighting in the Middle East. A key lesson that applies to high-intensity operation is the ability to integrate sensors with long range precision fires to create a very short kill-chain (find, fix, fire, finish, feedback). This lesson has important implications for the development of future, possibly automated, kill-chains. The results of these lessons have driven the development of smaller and better sensor systems, faster missiles (hypersonic missiles that fly from Mach 5 to above Mach 20), additional missiles closer to the target, jammers, radar

spoofers to avoid enemy air defenses, and artificial intelligence (AI) to provide feedback and optimise follow-on strikes.

Strategy: The strategic lessons of the past twenty years of war in the Middle East are many, but the most obvious is that to employ political and military power requires a definitive strategy to achieve strategic aims through the use of policy, the military, and the support of the people. There are always consequences in war. As President Obama's Deputy Secretary of State Tony Blinken said, we cannot deny "the lessons we've learned over a decade of sacrifice about the effectiveness and sustainability of indefinite and undefined military interventions that have vast unintended consequences." Or, better put, as Walter Russell, a polymath and philosopher known as the "modern Leonardo" of the 20th Century, stated: "The essence of strategy is to align your ends with your means: to match your goals and your resources." A key step is first having a clear goal, know the strategic aim, and ensure the aim is achievable. Strategy matters.

These are but a few of the lessons of the fighting in the Middle East. The Middle East has been described as the crucible of conflict and the graveyard of empires. It is too important to ignore the lessons of the last

two decades of combat; they hold key insights that cannot be ignored. The US Army recently published a two volume study on the lessons learned from the fighting in Iraq. A similar study concerning Afghanistan is needed. On the Russian side, General Valery Gerasimov, the chief of the General Staff of the Russian Armed Forces, believes that the Syrian conflict represents "contours of future war" and that Russia is learning priceless lessons on how to conduct operations and use the latest military technologies including robotic systems, drones, sensors, long range precision fires, C4ISR, and AI. Just as the Spanish Civil War was the incubator for World War II, the Middle East has become a proving ground for future conflict. These lessons promise to shape the form of wars to come.

Colonel John Antal, US Army (Ret.) served thirty years in the US Army as an armor officer in combat arms units. He is a military affairs expert, the author of fourteen books on military subjects, a professional developer of military software applications and simulations, and a life-long student of the art of war. His latest book, 7 Leadership Lessons of D-Day, Lessons from the Longest Day, June 6, 1944, was published in September 2017. ■

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NATO's Multinational Hub of Cyber Defence Expertise

Team of Authors, CCDCOE

The NATO Cooperative Cyber Defence Centre of Excellence (CCDCOE) based in Estonia is a NATO-accredited cyber defence hub offering a unique interdisciplinary approach to the most relevant issues in cyber defence. This multinational military organisation conducts research, training and exercises in four focus areas – technology, strategy, operations and law. The heart of the Centre is a diverse group of international experts from military, gov-

ernment, academia and industry. To date the CCDCOE brings together 21 nations as its members, among them 18 NATO Allies. The mission of CCDCOE is to support NATO, its member nations, and the international community with wide-ranging cyber defence expertise.

The CCDCOE embodies and fosters the co-operation of like-minded nations in cyber defence. Our member nations are allies in NATO and like-minded partners beyond the

Alliance. CCDCOE is staffed and financed by member nations – to date Austria, Belgium, the Czech Republic, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, the Netherlands, Poland, Portugal, Slovakia, Spain, Sweden, Turkey, the UK and the US. Australia, Bulgaria, Denmark, Japan, Norway, Romania and many others are also on the path of joining the Centre.

In ten years since the establishment in 2008, the CCDCOE has earned recognition for its unique flagships – the world's largest and most complex international live-fire cyber defence exercise Locked Shields, international conference and community-building event CyCon and Tallinn Manual 2.0, the most comprehensive guide on how International Law applies to cyber operations.

Locked Shields

Locked Shields, organised by CCDCOE since 2010, is the largest and most complex international live-fire cyber defence exercise in the world. The annual real-time network defence exercise is a unique opportunity for national cyber defenders to practise protection of national IT systems and critical infrastructure under the intense pressure of a severe cyber-attack. The exercise involves around 4000 virtualised systems and more than 2500 attacks altogether. In addition to keeping up complex IT systems the training audience must be effective in reporting incidents, executing strategic decisions and solving forensic, legal and media challenges. To stay abreast of market developments, Locked Shields focuses on realistic and cutting-edge technologies, scenarios, networks and attack methods. More than 1000 cyber experts from 30 nations took part in Locked Shields 2018. In addition to new critical infrastructure components it included also a strategic game, enabling participating nations to practice the entire chain of command in solving a large-scale a cyber incident.

Crossed Swords

Crossed Swords organised by CCDCOE since 2016 focuses on developing tactical responsive cyber defence skills of cyber ex-

Photo: NATO CCDCOE



The CCDCOE hosts regular cyber defence exercises.

Photo: NATO CCDCOE



The annual Conference on Cyber Conflict CyCon has become a community-building event for cyber security professionals.

perts. The exercise aims to practice the skills required to fill the role of the Red Team and offer the most cutting-edge and challenging training experience for national cyber defenders. In 2018 for the first time the exercise brought together Critical Information Infrastructure (CII) providers, military units and specialised military equipment.

CyCon

CyCon, the annual International Conference on Cyber Conflict, addresses the most relevant issues concerning the cyber defence community. In the ten years of its existence, CyCon has become a community-building event for cyber security professionals, adhering to the highest standards of academic research and bringing to Tallinn around 600 decision-makers, opinion-leaders, top military brass, law and technology experts, from the governments, military, academia and industry of around 50 countries. In 2018, the event focused on the theme of maximising effects in the cyber domain. Keynote speakers included H.E. Kersti Kaljulaid, the President of Estonia, Alex Stamos, Chief Security Officer of Facebook, Dr. Antonio Missiroli, NATO Assistant Secretary General on Emerging

Security Challenges, H.E. Toomas Hendrik Ilves, former President of Estonia, Thomas Dullien, Staff Software Engineer at Google Zero and many others distinguished experts. In 2019, the 11th CyCon will take place from 28 to 31 May on the theme of „Silent Battle“.

The Tallinn Manual 2.0

The Tallinn Manual 2.0 is the most comprehensive guide for policy advisors and legal experts on how International Law applies to cyber operations carried out between and against states and state actors. An invaluable analysis by an international group of renowned scholars, published in 2017, it serves to inspire both academic research and state practice. The Tallinn Manual process is continuing at the Centre with a legal, technical, strategic and operational assessment of cyber scenarios, with the aim of publishing a practical reference source for Cyber Commands.

Cyber Security Training

CCDCOE promotes lifelong learning in cyber security. The training courses arranged by CCDCOE are based on the

latest research and cyber defence exercises of the Centre. CCDCOE is committed to continually improving the training offerings to address the changing needs of the ever-developing cyber security field.

As of January 2018, CCDCOE is responsible for identifying and coordinating education and training solutions in cyber defence for all NATO bodies across the Alliance. NATO Allied Command Transformation has provided CCDCOE with an unconditional quality assurance accreditation for its contribution to high-quality NATO Education and Training.

To best meet the training requirements of our Allies, Partners and NATO as a whole, courses are provided in different formats and locations, covering a broad range of topics in the technical, legal, strategic and operational cyber security domains. ■

Recent news, publications and upcoming courses are available at www.ccdcoe.org
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Facing the New Risks of Digitised Wars

Robert Janczewski

We are currently dealing with a new, unknown and unfortunately not sufficiently researched challenge: enemy actors, who are using new methods, techniques, and sophisticated cyber tools to gain an advantage over the victim. Today's battles are fought with bits and bytes, not just with bombs and rifles.

The recent history of international conflicts has shown that with the increasing dependence of societies on computerisation, it was only a matter of time before cyberspace was used to achieve tactical, operational, and strategic superiority in combat. Humanity has therefore reached the point where cyberspace and cyberspace activities have become an essential part of hybrid activities. This has been achieved by making the acquisition and control of ICT networks, systems, and infrastructures more attractive. In modern civilisations, critical infrastructure for the functioning of the state (electricity, communications, water, transport, finance, etc.) is based on cyberspace. Military command and control support systems also depend on cyberspace, as do all the most advanced technologies in today's battlefield.

The experience of modern conflicts shows how ingenious and dangerous actions are that use cyberspace to achieve their goals through anonymity. Even if the probability of the attribution is high, thanks to the good preparation of the cyber-attack, it will not be possible to identify its author unambiguously, and even if an opponent should be identifiable, the international legal system knows no conditions for drawing consequences against him. Therefore, any country that has certain cyber security capabilities, but does not have the appropriate policy in this area, must expect to fail in the future. Cyber operations can be planned as part of hybrid operations and include, in particular, the activities of specialised military units, intelligence services, organisations, hacker groups, or insiders.

Author

LTC **Robert Janczewski** is Senior Specialist at the National Cyber Security Centre of the Polish Ministry of Defence.

Photo: US Air Force



Cyber warfare specialists serving engage in training at Warfield Air National Guard Base in Middle River, Md., 3 June 2017.

Cyberspace as a Battlefield

Cyberspace as a battlefield has unique features attractive from the point of view of military operations. It allows you to interact with an enemy at a considerable distance (sometimes out of reach of conventional forces) in a short time, without risking the lives of soldiers. Conducting activities in physical domains, for example on land, sea, air, or space depends on geographical conditions. However, activities using cyberspace are not geographically limited. Cyber actions, however, depend on distributed network infrastructures, for example the physical layer of cyberspace.

The physical network layer is created by ICT devices and infrastructure in other domains (land, sea, air, space). They provide storage, transmission and processing of information in cyberspace as well as databases and connections that transfer data between network components. Network components include equipment and infrastructure (e.g. computers, memory devices, network devices as

well as wired and wireless connections). The components of the physical network layer require physical security measures to protect against physical damage or unauthorised physical access so that logical access can be achieved. The physical layer of the network during cyber activities is the first point of reference to determine the geographical location and appropriate legal framework.

Although geopolitical borders can be easily and quickly crossed in cyberspace, there are still sovereignty issues related to physical domains. Each material component of cyberspace is owned by a public or private entity that can control (sometimes restrict) access to its own resources. These unique features must be considered at all stages of the planning of activities.

From a cyber-security perspective, the ability to launch a quick cyber-attack forces you to have protection and defence systems that automatically respond to cyber-attacks in real or near real time. To be effective, these systems should have the best computing power possible.

The unique features of cyberspace make it attractive also in the breaks between activities of conventional forces. You can successfully perform cyber-attacks during such breaks.

Covert Operations

Cyberspace also creates conditions for covert operations. Identification of cyber activities is mostly based on the method of accomplished facts. This means that analysed cyber-attacks are those that have already occurred. A well-prepared cyber-attack, even if it contains already known elements, is different, innovative (techniques, tools) compared to the previous ones. In addition, the anonymisation of operations mentioned above is a strong attribute of the attacker. An attacker has the option of acting anonymously in cyberspace, without leaving any trace of identification. It can hide behind other entities, such as individual users of ICT networks and systems, hacker groups, criminal entities or even foreign agencies or countries by using appropriate techniques and tools. Cyberspace allows the attacker to minimise the risk of disclosure, prosecution and counterattack. This is evidenced by the fact that so far no state has been punished for conducting cyber-attacks. In conventional operations on the battlefield, it is usually known who attacked first, what space was acquired. During operations in cyberspace it is not so obvious or impossible to determine at all.

Cyberspace creates conditions for actions that have conflicting consequences. On the one hand, the possibility of a counterattack may be limited (the attacked entity will have no grounds or ability to respond). On the other hand, there is also the possibility of uncontrolled escalation. This is related to another feature of cyberspace operations. Well, contrary to popular belief that activities using cyberspace are bloodless, cyber-attacks can cause death for a large number of people. Destruction and deprivation of human life may occur as a result of damage, disruption or destruction of objects critical to the functioning of the state (e.g. power plants, water dams, refineries or production plants) based on their functioning on networks and ICT systems. Anonymisation of cyber activities can mean that even if cyber-attacks cause fatalities and serious damage to health, no adequate response or even accountability will be possible due to the lack of solid identity cards of the attacker. Therefore, the possibility of causing great damage to the functioning of the state without destroying its physical infrastructure or killing people may be considered a desirable feature of cyberspace by those planning hostile activities.



Photo: Pixabay



Photo: US Army Cyber Command / Michael L. Lewis

Cyber and military intelligence specialists monitor Army networks in the Cyber Mission Unit's Cyber Operations Center at Fort Gordon, Ga.

Top Ten Cyber Threats

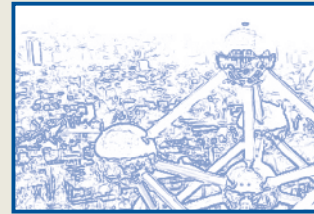
The attractiveness of cyberspace as an area of activity used during cyber-operations can be proved by the SANS Institute expert ranking. This classification indicates the top ten cyber threats:

- The increasing sophistication of attacks on websites that exploit browser vulnerabilities – especially on "trusted" sites;
- Increase of advancement and effectiveness of botnet attacks;
- Cyber-espionage activities carried out by organisations with appropriate resources that want to acquire large amounts of data – in particular through targeted phishing;
- Threats to mobile phones, especially iPhone phones, phones using the Android system, and those intended for VoIP (Voice over Internet Protocol) communication;
- Attacks of insiders;
- Advanced identity theft from permanent bots;
- Increase in malicious software from spyware;
- Exploiting vulnerabilities in web applications;
- Increased sophistication of social engineering, including combining phishing with the VoIP service and event phishing;
- Supply chain attacks infecting consumer devices (USB drives, GPS systems, photo

frames, etc.) disseminated by trusted organisations (producers).

Standardisation is another feature that causes cyberspace to be used during conflicts. Cyberspace is mainly based on solutions of companies with global reach (e.g. Microsoft, Cisco, IBM, Hewlett-Packard, Intel, Lenovo, Check Point, 3Com, Juniper Networks, Fortinet, or even Huawei), whose products are located in countries around the world. The universal nature of the cyber-domain in question is also shaped by operating systems (for example, Windows, Unix, or the most popular Linux distributions). Standardisation involves a high risk for the attacked site. Hacking of commercial (non-dedicated) database security software can bring further successes to a successful attacker because of the source codes and software structures that are uncovered. Cyberspace also creates conditions for hostile entities to obtain or change the value of many data from devices connected to the network and ICT systems. Geographical, thermal, mechanical or other data obtained from other domains using sensors in networks and ICT systems are converted into bits and vice versa. Based on this data, the effectors perform a specific action. The attacker, using cyberspace, can gain possession of this data, and by changing their parameters can affect the effects of many devices. Thanks to this, it can simultaneously create favourable conditions for conducting attacks in geographical domains. ■

The Brussels Backdrop



NATO and Ukraine

Joris Verbeurgt

In last month's Brussels Backdrop, we discussed the extraordinary history of Ukraine, torn between Russia and the West, and developments in Ukraine until the year 2000. In this issue, we will discuss developments as from the year 2000, when Russia under President Putin started to mingle in Ukrainian affairs to counter the pro-EU and pro-NATO course the country was pursuing. Under the presidency of the corrupt Leonid Kuchma, who was President of Ukraine between 1994 and 2005, ties between Ukraine and NATO were strengthened. In May 2000, the Ukrainian Parliament ratified the Partnership for Peace Status of Forces Agreement, and two years later, Kuchma announced Ukraine's goal of eventual NATO membership, a desire that was welcomed by NATO. The relationship was taken to an entirely new level when in November 2000 the NATO-Ukraine Action Plan was adopted at a NATO – Ukraine Commission (NUC) meeting of foreign ministers in Prague. The Action Plan aimed to deepen and broaden the NATO-Ukraine relationship and to support Ukraine's reform efforts on the way towards Euro-Atlantic integration. In spring 2004, the Ukrainian Parliament ratified the Host Nation Support Agreement and a Strategic Airlift Agreement with NATO.

A few months later, internal political turmoil in Ukraine affected the relationship with NATO. New presidential elections were held in November 2004, but they were marred by massive corruption, voter intimidation and electoral fraud. The authorities rigged the elections in favour of Viktor Yanukovich, the pro-Russian candidate, at the expense of the candidate of the opposition, the atlanticist Viktor Yushenko, who also suffered from a sudden dioxin poisoning during the campaign.

The Orange Revolution of 2004

Nationwide protests erupted and the capital Kiev became the focal point of civil resistance campaigns, sit-ins and general strikes. Thousands of protesters demonstrated daily and the revolution came to be known as the 'Orange Revolution', as orange was the colour of Yushenko's election campaign. Under huge popular and international pressure, a second run-off was held, as a result of which Yushenko was victorious. His inauguration as president on 23 January 2005 ended the Orange Revolution. Yushenko as a pro-Western head of state intensified relations with NATO, and in February 2005, Yushenko was invited to a summit meeting at NATO Headquarters. The NATO members expressed their support for his ambitious reform agenda and agreed to refocus NATO-Ukraine cooperation in line with the new government's priorities. An Intensified dialogue on Ukraine's aspirations to NATO membership and a package of short-term actions to strengthen support for key reforms were launched, and in October 2005, Ukraine hosted a multinational disaster-response exercise, Joint Assistance 2005. In 2006, a Resettlement and Retraining Centre was inaugurated in Khmelnytskyi and a contract was signed for the launch of a project to destroy tonnes of conventional munitions, small arms and air defence systems.

In August 2006, Yanukovich became Prime Minister of Ukraine, and, while Yushenko was still President, he immediately altered the nature of cooperation with NATO. Although Yanukovich, during a visit to NATO in September 2006, reassured the Allies of Ukraine's commitment to ongoing cooperation with NATO, he also said that the Ukrainian people were not yet ready to consider possible NATO membership. Cooperation continued (for example: Ukraine sent medical personnel to support a Provincial Reconstruction Team in Afghanistan in 2007), but no big steps forward towards full membership were taken. NATO leaders, however, still aspired NATO membership for Ukraine, a statement that was launched at the Bucharest Summit in 2008. The statement was further formalised with the signing of a "Declaration to Complement the Charter on a Distinctive Partnership between NATO and Ukraine" in August 2009. However, when Yanukovich became President in 2010, he immediately took his country's membership off the agenda. Cooperation continued, but at a lower level and at a slower pace; for example, a memorandum of understanding on Air Situation Data Exchange (ASDE) was signed, with the objective of reducing airspace conflicts by minimising potential cross-border incidents. In 2010, Ukraine deployed a ship in support of Operation Active Endeavour and in February 2013, Ukraine became the

The Euromaidan revolution in Kiev in February 2014. Depicted is the House of the Labour Unions.

Photo: via author





Photo: MoD Ukraine

There is still fighting going on in the Donbass region of eastern Ukraine, where Russia is supporting paramilitary troops.

first partner country to contribute to NATO's counter-piracy operation off the coast of Somalia, Operation Ocean Shield.

Euromaidan in 2014

In 2014, large parts of the Ukrainian people (especially those living in the Western part of the country) were fed up with Yanukovich's pro-Russian and anti-Western stance. When he kept postponing an association agreement with the European Union, which would have provided Ukraine with loans in return for liberal reforms, many Ukrainians saw this as an attempt to back out of signing this agreement. The agreement would have complicated Ukraine's trade relationship with Russia, its biggest trade partner at the time, and therefore, Yanukovich did not favour it. The consecutive postponements of the agreement led to a wave of protests which came to be known as the "Euromaidan" movement. In February 2014, a series of violent events erupted, involving protesters, riot police, and unknown shooters in Kiev, culminating in the ousting of the elected Ukrainian President Viktor Yanukovich and the overthrow of the Ukrainian Government. Nearly 130 people, including 18 police officers, lost their lives in this revolution. Yanukovich fled to Russia and was declared a traitor by the Ukrainian Parliament. New elections brought the pro-Western Petro Poroshenko into power and the EU association agreement was signed. Poroshenko also signed into law a bill to cancel the non-bloc status

of Ukraine and announced that Ukraine will start a process to achieve the criteria needed for NATO membership and also integrate with the Euro-Atlantic security space. Was Euromaidan a genuine people's revolution against a corrupt and authoritarian regime, or an illegal armed coup against an elected government? Political scientists and scholars of Ukrainian and international law are still debating the matter.

The Russo-Ukrainian War

Russian President Putin reacted swiftly on the unexpected and rapid expulsion of the pro-Russian elements in the Ukrainian Government organs. Russia somehow needed to compensate this loss of influence in Kiev and reacted by invading and annexing the Crimean Peninsula, home to the Russian Black Sea Fleet and Russian territory before Khrushchev transferred the Crimea from Russia to Ukraine in 1954. The US, the EU and NATO (and many others) condemned the annexation, but were unable to react with other means. The Ukrainian defence forces were no match for their Russian counterparts and had to give up the Crimea in a matter of hours. In a referendum, a large majority of Crimeans voted for the reunion with Russia.

Simultaneously with the military intervention in Crimea, Russia-backed paramilitary troops invaded the Donbass region in Eastern Ukraine. Fighting is still going on and an estimated 13.000 people, soldiers and civilians,

have since lost their lives. The conflict gained much international attention when Malaysia Airlines Flight 17 (MH17), a scheduled passenger flight from Amsterdam to Kuala Lumpur, was shot down on 17 July 2014 while flying over eastern Ukraine. All 283 passengers and 15 crew died.

In response to the Russia-Ukraine conflict, NATO reinforced its support for capability development and capacity-building in Ukraine. The Allies continue to condemn Russia's illegal annexation of Crimea, and what they call "its destabilising and aggressive activities in eastern Ukraine and the Black Sea region". NATO increased its presence in the Black Sea and stepped up maritime cooperation with Ukraine as well as with Georgia. Since the NATO Summit in Warsaw in July 2016, NATO's practical support for Ukraine has been subsumed in the Comprehensive Assistance Package (CAP) for Ukraine. In June 2017, the Ukrainian Parliament adopted legislation reinstating membership in NATO as a strategic foreign and security policy objective. Not much else could be done: in Ukraine, NATO is confronted with a fait accompli by Russia. And as long as Russia and Ukraine are at war, NATO membership for Ukraine is out of the question.

Zelensky

Could the surprising election of the comedian Volodymyr Zelensky as President of Ukraine on 20 May 2019 be a turning point in the 5-year old conflict? When he visited NATO Headquarters on 4 June to discuss the security situation in Ukraine and NATO's continued support for Ukraine, Zelensky underlined his eagerness to give new impetus to his country's engagement with NATO. At the same time, Zelensky is eager to stop the grinding conflict with Russia that Ukraine can never win and that engulfs the resources of the country, dearly needed for other purposes. Early September, dozens of prisoners were swapped as "the first step to end the war." Welcoming 35 freed Ukrainians at the airport in Kiev, the President said that he had spoken by telephone with Russia's President Putin, and that they had reached an agreement "on the first stage to unblock our dialogue and on the first step to stop the war."

Light Tactical Vehicles

Sidney E. Dean

Light tactical vehicles (LTVs) provide mobility for infantry forces over a wide array of terrains. In addition, they can be armed with a variety of crew-served weapons including machine guns, anti-tank guided missiles (ATGMs) and air-defence weaponry.

Modern LTVs normally provide enhanced crew survivability such as rollover protection, reinforced or v-shaped bottoms to minimise the effect of mines and improvised explosive devices (IEDs), and organic or modular armour against small arms fire. However, neither armour nor firepower of LTVs can match the capabilities of armoured fighting vehicles.

Marine Corps (USMC) as a successor to the High Mobility Multipurpose Wheeled Vehicle or "HUMVEE".

Precise figures are in flux. The USMC had originally planned on 5,500 units, a figure which was increased to 9,000 vehicles. In mid-August the Corps announced that it would be increasing procurement again to a total of 15,000 JLTV. This will allow for a 100% replacement of the USMC's

Balancing Mobility, Protection and Firepower

A major characteristic of the JLTV is the organic crew protection. JLTVs are equipped with two armour levels: the A-structure, or base vehicle, includes a v-shaped hull to deflect blast energy from mines or IEDs, bulletproof windows, and an armoured crew cabin. Additional survivability equipment includes blast-protected seats and an automated fire extinguishing system. The modular B-kit add-on armour suite provides enhanced protection against enhanced small arms, fragmentation, and underbody threats, effectively increasing crew protection to MRAP levels.

Additional enhancements have been introduced based on soldier feedback during operational testing. These include larger rear windows and a forward looking camera to enhance situational awareness. A muffler was added to reduce the vehicle's noise signature. While no decisions have been made regarding mounting an Active Protective System, both the IMI IRON FIST and the Rafael TROPHY Light APS have been evaluated on the JLTV.

Depending on terrain and payload, the JLTV has an unrefuelled radius of 480 kilometres and a top speed (on road) of 120 kph. The 6,400 kg vehicle can be transported by fixed-wing aircraft (C-130, C-17, A400) and heavy lift helicopter (CH-47, CH-53), and arrives ready to deploy. It can also be carried aboard amphibious landing craft. The proprietary Oshkosh TAC4i suspension enables off-road performance exceeding that of the unarmoured HUMVEE, while ensuring a more comfortable ride and reducing crew fatigue.

The JLTV is equipped with a complete interface for battlefield C4ISR networks and plug-and-play situational awareness equipment, and retains sufficient modular capability for integrating future technologies. Each vehicle can be reconfigured in the field to meet operational requirements.

Photo: US Marine Corps



A JLTV displays its ability to handle multiple terrain types by physically adjusting its suspension during a demonstration at the School of Infantry West, Marine Corps Base Camp Pendleton, California, 27 February 2019.

JLTV

By far the largest LTV acquisition programme worldwide is the US armed forces' JLTV programme. Approximately 60,000 Joint Light Tactical Vehicles are to be procured by the US Army and the US

HUMVEEs. While USMC procurement was originally slated to be completed by 2022, the increased end-strength will extend the acquisition timeline through the early 2030s.

The US Army, for its part, is likely to reduce its planned purchase of 49,000 units through the mid-2030s. Army Undersecretary Ryan McCarthy has suggested a cut of circa 2,000 units overall, but a final decision is not expected for at least another year. The Army's decision is driven partially by the need to free up funding for higher priority modernisation projects.

Author

Sidney E. Dean is President of Transatlantic Euro-American Multimedia LLC. and a regular contributor to ESD.

Family of Vehicles

JLTV comes in two basic variants: the Combat Support Vehicle (CSV) designed to seat two passengers and carry a 2,300 kg payload, and the Combat Tactical Vehicle (CTV) which seats four and has a 1,600 kg payload capacity. These variants can be configured for specific mission categories (mission package configurations).

The CSV currently has one mission package configuration, the Utility Prime Mover (UPM) variant that can either transport cargo or accept a shelter on the vehicle's flatbed. A prototype mounting the Boeing Maneuver Short-Range Air Defense System (M-SHORAD) consisting of an M299 launcher with four LONGBOW HELLFIRE missiles, was presented to the Army, which ultimately decided to acquire a different M-SHORAD system. A prototype mounting a 105mm howitzer has also been demonstrated, although the Army currently has not opted to procure that configuration. Oshkosh has also developed a prototype field ambulance based on the JLTV UPM; it can accommodate four litter patients or eight ambulatory patients.

The CTV has three configurations: the General Purpose (GP) vehicle carries a stand-



Photo: Oshkosh Defense.

JLTV Family of Vehicles

ard load of four combat troops, but is not configured as a combat vehicle; and two armed vehicles designated as the Close Combat Weapon Carrier (CCWC) and the Heavy Guns Carrier (HGC), respectively. The CCWC is designed to deploy TOW Anti-Tank Guided Missiles (ATGMs). The HGC can be equipped with manned or remotely operated weapons mounts and can accommodate a wide range of guns, cannon and tube-launched weapons. Side- and rear-mount-

ed weapons can also be accommodated. Weapons options include, but are not limited to 7.62mm and 12.7mm machine guns, automatic grenade weapons, 30mm chain guns, and Javelin ATGMs. Furthermore, the USMC plans to field JLTV-mounted Ground Based Air Defense (GBAD) systems deploying STINGER missiles against low-flying threats in FY 2020. An upgraded GBAD incorporating a counter-drone laser weapon is to follow in FY 2021.



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The Joint Light Tactical Vehicle (JLTV) Heavy Gun Carrier is extracted from a C-17 cargo aircraft as part of airdrop testing at Fort Bragg, N.C.



Similar to a touchscreen computer found in a newer car, the driver's smart display unit on the centre console monitors the Joint Light Tactical Vehicle's fluids, filters, tire air pressure and even has a rearview camera.



Members of the 22nd Marine Operational Test and Evaluation Squadron carefully drive the new PHANTOM BADGER tactical vehicle into an MV-22 OSPREY tiltrotor aircraft during a fit test, 26 September 2014. It is six inches narrower than a Mini Cooper as it was designed to be loaded on an OSPREY.

According to US Army planning, JLTV will be employed as a light, tactical-wheeled vehicle to support all types of military operations and units including airborne/air assault, amphibious, light, STRYKER, and heavy forces. JLTVs will function as reconnaissance, manoeuvre, and manoeuvre sustainment platforms. Small ground combat units will employ JLTV in combat patrols, raids, long-range reconnaissance, and convoy escort.

Entering Service

The US Army approved JLTV full rate production beginning in May 2019. The first operational brigade was equipped with 300 Low Rate Initial Production (LRIP) units in spring of this year. The USMC declared Initial Operational Capability (IOC) for the JLTV in August, nearly a year ahead of schedule. It simultaneously announced plans to begin equipping field units within a month. Infantry battalions are to receive 69 vehicles each.

According to Andrew Rodgers, the JLTV (or immediate derivatives) are expected to remain in service through the rest of the century. "We are really at the starting line right now. Our grandchildren and great-grandchildren will see JLTVs in the DoD," said Rodgers. "We'll easily still have these assets somewhere in the DoD in the year 2100. Welcome to the start of many generations of JLTVs."

In addition, the US Army and USMC as major operators, the US Air Force intends to purchase 80 units for missile site security and special operations forces. JLTV is expected to also garner a significant export market. Negotiations have already begun, with Slovenia signing the first contract (for 38 units) in November 2018. Lithuania submitted a procurement request with the US government in February of this year. The United Kingdom initiated talks with the Pentagon as early as 2016, and is likely to acquire more than 2,700 units to satisfy the Army's Multi-Role Vehicle – Protected requirement.

Infantry Squad Vehicle

In addition to the JLTV, the US Army is procuring a new lightweight platform capable of carrying nine combat-equipped soldiers around the close battle area. The vehicle's primary purpose is to enable airborne and airmobile soldiers to land further from their objective, evading enemy air defences and detection. Designated as the Infantry Squad Vehicle (ISV), it will weigh a maximum of 2.200 kg empty, and be air transportable by all means including sling load (UH-60),

Photo: GDELS

Two German GAZI armored vehicles, painted in camouflage, are shown driving through a grassy field. They are equipped with large, treaded tires and have mounted sensors or cameras on their roofs. The background consists of a dense line of green trees.

The competing SAIC/Polaris team is basing its offer on the Polaris DAGOR. The largest of the Polaris vehicle family, the DAGOR is currently in service with the US Army's 82nd Airborne Division. SAIC would be responsible for system integration if this prototype is selected. A production contract award to a single vendor is scheduled for 31 March 2020.

The PHANTOM BADGER LTV was developed by Boeing in collaboration with MSI Defense Solutions to meet a special operations forces (SOF) requirement. Depending on configuration it accommodates between two and five soldiers. The base weight is 3,400 kg, with a payload capac-

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[illegible][illegible]10/2019 · **European Security & Defence**

Photo: KMW



The Krauss-Maffei Wegmann AMPV was tested in the arid highlands (4,000+ metres above sea level) of the Chilean Salar del Huasco nature preserve.

Photo: Arquus



The SCARABÉE protected LTV prototype from Arquus

Photo: Arquus



The Arquus SHERPA LIGHT is operated by the French army and by other armed forces worldwide.

ity of 1,590 kg. Operational range is 720 km, with a top speed (on-road) of 130 kph. The vehicle can be configured according to mission requirements. Armament options include a 12.7mm machine gun or 40mm grenade launcher, plus up to two 7.62mm machine guns. Uses include special reconnaissance, explosive ordnance disposal, combat search and rescue, and casualty transport. A single PHANTOM BADGER can be transported internally in the V-22 OSPREY, and two can be transported inside the CH-47; ten can be accommodated in a C-130. It is used by US Air Force SOF and USMC SOF.

MOWAG EAGLE V

The EAGLE V introduced in 2013 is the latest variant of the General Dynamics Land Systems/Mowag LTV family. The manufacturer offers the EAGLE V in a 4x4 and a 6x6 variant. Basic weight is 7,000 kg and 7,700 kg, respectively. Classified as a light protected vehicle, the EAGLE seats between four and fourteen depending on variant and configuration. Payload capacity varies between 3.3 and 6.9 tonnes, depending on variant. The EAGLE V features level 2 ballistic armour and level 2a mine protection. The v-shaped hull is designed to deflect blast from mine and IED explosions, while blast absorbing seats reduce the risk of shock-induced injury. Modular armour is available to enhance ballistic protection. A remote weapons station can mount machine guns up to 12.7mm, and 40mm grenade launchers. Optional equipment includes an RPG protection kit and an NBC-overpressure system. Operational range is 650 kilometres, with an on-road speed of up to 110 kph. The EAGLE V has been acquired by the German army to serve as protected command vehicles, and by the Danish army which chose four different configurations optimised for patrol, electronic warfare, support and reconnaissance.

Armoured Multi Purpose Vehicle

The Armoured Multi-Purpose Vehicle (AMPV) jointly developed by Rheinmetall and Krauss-Maffei-Wegmann is offered in two variants. According to the manufacturer, the smaller Type 1 is suitable for carriage inside a CH-53. The vehicle is optimised as a command or liaison vehicle; a special patrol version is being developed. The Type 1 has a base weight of 7.3 tonnes and a 2.6 tonnes payload, with capacity for five soldiers. The larger Type 2 weighs 9.9 tonnes and features a higher level of protection

and a greater payload, but otherwise displays structural commonality with the Type 1. Both variants can be equipped with a roof-mounted weapon station mounting a 12.7mm machine gun or a 40mm grenade launcher, and a smoke generation system. The manufacturer states that the vehicle handles like an SUV, but features a high level of occupant safety due to the self-supporting monocoque made from armour steel and composite armour. An NBC filtration and overpressure system is available. The turn radius of 15 metres makes the AMPV suitable for urban operations, while the independent suspension enables high performance in broken terrain, including the ability to climb a 70% gradient. Maximum speed is 110 kph, with a 700 kilometre operational range.

Photo: Credit: Jankel



In January 2016 the Belgian armed forces awarded a contract to Jankel for the delivery of 108 FOX Rapid Reaction Vehicles (RRV).

Arquus SCARABÉE

The SCARABÉE developed by Volvo's French subsidiary Arquus (formerly Renault Military Trucks) is a candidate for the Véhicule Blindé d'Aide à l'Engagement programme intended to replace the French army's fleet of protected combat support vehicles by 2025. The four-seater SCARABÉE has a base weight of 6.6 tonnes and a two tonnes payload capacity. The vehicle can be internally carried in a CH-47 or tactical fixed-wing transports. It can be air dropped from low altitude without a parachute, and is operational within fifteen minutes of landing.

Photo: Paul Hermans



A Belgian special operations forces FOX RRV in camouflage netting during a parade in 2018

The composite-and-steel armoured hull provides small arms ballistic protection, while the chassis and hull are configured to minimise blast effects. Performance parameters include a top speed of 120 kph. Roof mounted weapons options include a 12.7mm machine gun, a 30mm anti-tank gun, or a medium-range missile launcher. A surveillance radar can be mounted in place of a weapon. Other surveillance technology includes cameras and acoustic gunfire localisation systems. The on-board BattleNet vectronics system networks all on-board equipment and systems including sensors and weapons, and connects the vehicle to the tactical battlefield network.

In addition to these state of the art characteristics which are found on various other LTVs, the SCARABÉE displays some revolutionary innovations:

- Hybrid propulsion: The SCARABÉE is equipped with both a 300 hp Diesel engine and a 103 hp electric motor, both mounted in the rear. The Diesel provides primary propulsion, enabling an operating range of circa 1,000 kilometres. In contrast, the twin batteries powering

- the electric motor only store enough energy to traverse circa ten kilometres. The electric drive is intended to provide short-term special performance. Alternately, the electric motor can operate for hours to power on-board systems during surveillance missions.
- Boost mode: By engaging both engines simultaneously the vehicle en-

ters "boost mode", providing more rapid acceleration than any comparable LTV. According to the manufacturer, this boost mode is sufficient to evade an incoming ATGM.

- Stealth mode: The electric motor can be engaged during the final approach to target, eliminating the Diesel's noise and thermal signature.

Masthead

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- Independently powered wheels: Each of the four wheels can turn independently. This provides unprecedented manoeuvrability, enabling the vehicle to literally turn on the spot or to drive sideways to evade an obstacle or threat.

Sliding doors: the SCARABÉE is equipped with two van-style sliding doors which facilitate egress in close quarters such as an urban setting.

Remote control: The crew can dismount and operate the vehicle remotely. Among other scenarios this enables the crew to park or hide the SCARABÉE and advance on foot, but summon the vehicle if needed. The separately developed vehicle trailer which can carry an additional four tons of equipment can also be remotely operated as a "mule".

Renault SHERPA

The Renault SHERPA family of LTVs, also produced by Arquus, is utilised by various NATO forces and in other regions. Applications include reconnaissance, patrol, command and liaison, special forces, weapon system carrier, troop transport, forward logistics, and ambulance. Depending on configuration, the SHERPA can mount multiple machine gun and cannon systems up to 30mm, anti-tank or air-defence missile launchers, mortar, recoilless 105mm cannon, surveillance systems and/or an assault ladder. The BattleNet vectronics system ensures situational awareness and tactical connectivity. Scalable modular armour is available for ballistic, mine- and IED protection in compliance with STANAG 4569. The 10.4 tonnes vehicle is air-transportable in fixed wing aircraft (C-130, A400), and has an operational range of 1,000 kilometres and a maximum road speed of 110 kph. The SHERPA can handle a 60% gradient, a 40% side slope, and ford one metre of water. The French MoD placed an order for 241 light patrol vehicles and 202 heavy vehicles in December 2015; they are being procured for the French SOF.

Jankel FOX

Britain's Jankel offers a family of militarised Toyota utility vehicles under the series designation FOX. The FOX-r LTV is based on the Toyota LANDCRUISER 79, while the FOX-x LTV is based on the Toyota HILUX. The FOX Rapid Reaction Vehicle (RRV) is available on the basis of either variant. The major difference is found in the transmission system, with the FOX-r based vehicle featuring manual transmission, while the FOX-x has automatic transmission. The open-topped RRV can be equipped with add-on armour as required. The RRV mission profile encompasses SOF direct action, special reconnaissance and military assistance, as well as humanitarian missions such as security and assistance after catastrophes and crises, and non-combatant evacuations. The 4,500 kg vehicle can be internally deployed via CH-47. Depending on variant, the operational range will vary from 900 to 1,300 kilometres, with a configuration-dependent payload capacity; road speed is 120 kph. The Fox Long Range Patrol Vehicle (LRPV), a different variant than the RRV, has a 1,500 kilometre range. It can carry up to six personnel. Jankel cites missions ranging from border patrol to surveillance and reconnaissance, first support/force protection, convoy support and use in urban operations.

Primary weapons options for the FOX family of vehicles centre around 12.7mm machine guns and grenade launchers. The Belgian SOF in 2016 ordered the FOX RRV to replace its unprotected ILTIS vehicles.

Small but Excellent

Denmark's Procurement Authority



Photo: DALO

The Danish Ministry of Defence Acquisition and Logistics Organisation (DALO) is the specialised materiel centre and logistics authority of the Danish MoD. The organisation procures, maintains, and develops material capacities and ensures the timely provision of Danish defence operations. ESD had the opportunity to speak with Lieutenant General Flemming Lentfer, Commander of DALO and Denmark's National Armaments Director.



Graphic: DALO

ESD: How long has DALO been in existence, what is the structure, and what are the main tasks of your organisation?

Lt Gen Lentfer: The Danish Ministry of Defence Acquisition and Logistics Organisation (DALO) has existed since 2007. We are the specialised materiel centre and logistics authority of the Danish Defence including Danish Home Guard and Danish Emergency Management Agency. The organisation develops, procures, maintains, and decommissions defence capabilities and ensures provisions for the Danish Defence, National Guard and Emergency Management Agency. DALO administers an annual budget of DKK7Bn to DKK10Bn, roughly 40% of the total defence budget. We have approximately 2000 employees located all over Denmark.

ESD: If you compare DALO with other defence procurement organisations like Sweden's FMV or Germany's BAAINBw, where do you see commonalities, where differences?

Lt Gen Lentfer: DALO has close and good cooperation with the Swedish FMV, the German BAAINBw and many similar procurement organisations. DALO's structure and responsibility is optimised to serve the Danish Armed Forces in the best possible and most effective way. Based on talks with German and Swedish colleagues and soldiers, these organisations (FMV and BAAINBw) have the same focus on effective procurement in regard to the pivotal task of delivering 'on time and within budget'.

The different national structures, organisational cultures, and areas of responsibility have formed the three nation's procurement organisations in order to solve their respective tasks.

ESD: Are there any projects within the scope of DALO, wherein DALO cooperates with other defence procurement organisations, including CNAD, NSPA, EDA and OCCAR?

Lt Gen Lentfer: The most important cornerstones in Danish national security are, of course, NATO, but also bilateral and multinational cooperation. DALO is very active on the project and executive level in multinational cooperation (NATO, NORDEFCO), and with other defence procurement organisations. Denmark participates actively in 33 current projects under CNAD, with lead in two projects. Denmark is also participating in the NATO Support and Procurement Organisation (NSPO) as the subsidiary body to the North Atlantic Council. Denmark is supporting the Smart Defence initiative and thus considers the NATO Support and Procurement Agency (NSPA) as the "Contract Integrator" for NATO. In this respect, Denmark supports the Agency's 2018-2022 strategic direction which provides responsive, effective and cost-efficient support to operations and exercises worldwide. From a governance perspective, Denmark is participating in the work of the Agency Supervisory Board (ASB) in order to ensure the Agency's continued relevance to NATO and its member nations. This important role will be secured and supported through the Support to Operations and Life Cycle Management Directorates. Denmark will continue to participate actively in the Strategic Advisory Group (SAG) supporting the work of implementing SAG

roles and responsibilities and assess various objectives against the annual NSPA Business Plan. Denmark supports the current tendency to outsource solutions, which are seen in the Defence and Deterrence work, where NSPA now has become an integrated part of NATO's planning.

Due to the Danish opt-out on European defence cooperation our participation in EDA and OCCAR projects is very limited. However, Denmark has applied for observer status in the EDA.

ESD: Do DALO's responsibilities include research and development efforts for new defence materiel? How do you align the EDIDP Programme with industry and national requirements?

Lt Gen Lentfer: DALO is responsible for the Danish Defence Research and Innovation Fund – a programme designed to foster not only the development of defence-related technologies but also to build an expansive network of research, industrial and academic capacities able to go beyond the capabilities inherent in DALO and the Danish Defence. The fund is entitled and funded through the current defence agreement and aims at the lower technological readiness levels (TRL ≤6). Calls for proposals vary but will often include requirements based on recent trends as identified in, for example, NATO's Science and Technology Organisation (STO). To be eligible for co-funding applicants must demonstrate technological relevance to defence application, generation of new knowledge applicable to the Danish industrial base, an international element and finally prove that projects are genuinely research and development-driven.

Photo: ESUT



In 2015, DALO contracted GDELS to deliver 309 PIRANHA 5 vehicles. Delivery started in 2018 and the vehicles were officially handed over to the forces in late March 2019.

potential future defence capability requirements. It tables executive management of leading research institutions, industry representatives and ministerial bodies (business, development/science, foreign affairs, finance and defence).

Denmark's defence industrial base is proportionally smaller than that of other member states. Therefore, defence industrial competencies and national requirements typically evolve in parallel in a 'national defence ecosystem' between the defence forces, research bodies, and industry. Appreciating the limited defence industry in Denmark but recognising that industrial competencies do represent a national security interest, DALO supports a wide range of technologically diverse projects within the scope of the EDIDP. The EDIDP and EDF offer particularly strong incentives for small and medium-sized Danish enterprises to engage and develop enabling technologies with industry-leading companies from other EU member states – this is considered a strategic driver not alone for the companies, but also for Denmark as cooperative research and development as well as transfers of existing

technology may boost our national industrial competence.

ESD: What are the most important defence procurement programmes for the Danish armed forces -current and future?

Lt Gen Lentfer: The acquisition of the 27 F-35 LIGHTNING II is, historically, the single largest procurement for Danish Defence.

Other than that, DALO has signed a contract with NEXTER Systems for the acquisition of 15 CAESAR 155mm howitzers 8x8 to be delivered to the Danish Army in early 2020 and an additional 4 systems to be delivered in 2023. The project is well on track and the design of the howitzer (and cabin) has recently been finalised. The initial delivery will commence December 2019-2020 in order to conduct thorough vehicle inspection and training of drivers and crew at the 1. Artillery Regiment.

The Danish Army's ambition is to have set up a modern artillery regiment by 2023 to support the brigade level.

In addition to the acquisition of new 155mm artillery Denmark has signed a contract with ESLAIT (on behalf of ELBIT SYSTEMS) for the acquisition of 15 modern CARDOM10 120mm heavy mortar systems. These are to be mounted in the new armoured personnel carrier PIRANHA 5 from GDELS MOWAG. This acquisition will add a modern fire support capability to the battalion level. In order to gain the full potential of the two new capabilities, Denmark has initiated a munitions programme in order to establish a modern portfolio

of 155mm artillery and 120mm mortars. As we speak, 44 LEOPARD 2A7 tanks are being upgraded. They are expected to be delivered between 2019-2023. Some of the major improvements are new 120mm L 55A1 cannons, installation of a New Operating Concept, renewal of sensors, air conditioning, upgrade of the undercarriage/body of the tank and a better (ballistic) protection.

Moreover, the Danish army is currently integrating units and platforms in a digitised network. This will include new fire support capabilities and allow the digital transfer of data between forward observers to the fire planning cell and in the end to effectors (howitzers, mortars or air assets). This will reduce both time, the risk of errors and ensure a more flexible use of available capabilities (sensors and effectors) on the battlefield. The digitised network (SITAWARE) is developed by the Danish company SYSTEMATIC. Implementation of modern autonomous artillery, modern autonomous heavy mortars, a complete munition portfolio and the integration of all elements in a digitised network will obviously represent major changes for the Danish Army allowing effective fire support in both battalion and brigade level operations.

Additionally, the recent defence agreement stated that our frigates are going to be prepared and equipped with missiles to defend and protect naval forces and coastal areas against enemy aircraft and certain types of missiles. Area air defence is central to credible deterrence and collective defence. With the new missiles, the frigates would also be able to deploy to international operations in a littoral area air defence role. As part of preparing the Navy frigates for carrying missiles, a number of SM-2 missiles will be acquired, and initial preparatory work will be commenced with the prospect of acquiring SM-6 missiles with a longer range. This provides Denmark with a more complete frigate capacity that meets NATO's force goals on maritime area air defence.

As a part of the defence agreement, DALO is also going to acquire anti-submarine warfare material. The armed forces will build an effective anti-submarine capacity that can both track and combat submarines. The anti-submarine capacity consists of the following:

- Three of the Navy's frigates and support ships will be equipped to take part in anti-submarine warfare by equipping them with sonar equipment that can detect submarines.
- Anti-torpedo systems will also be acquired, so ships equipped with such systems can defend themselves against enemy torpedoes.

- A number of dipping sonars will be purchased for the Air Forces' SEAHAWK helicopters so they can participate in anti-submarine warfare.
- Torpedoes will be procured for the SEAHAWK helicopters.

The Danish Defence will also prioritise enhanced cooperation with other countries regarding education and training in anti-submarine warfare. A Danish anti-submarine capability thus fulfils NATO's force goals under this headline.

PIT is an IT transformation and consolidation program within the Danish MoD. The programme has been established as a part of The Defence Agreement 2018-2023 with the aim to make the Danish Defence's complex IT-structure more stable, efficient and safe. PIT's purpose is, therefore, to consolidate and transform IT across the entire Defence. PIT's scope contains everything that concerns IT in the Danish Defence. This includes all IT-services - both those used primarily militarily and those used administratively, including technical solutions, processes, personnel and regulations. The programme has three main goals; increased operational effectiveness, optimal cybersecurity and high efficiency.

ESD: What is the role of DALO in the NORDIC DEFENCE COOPERATION VISION 2025?

Lt Gen Lentfer: NORDEFECO's structure is integrated into the Danish Armed Forces structure in the sense that meetings are conducted on all levels from the Minister of Defence to soldiers testing equipment and conducting exercises/training together. Furthermore, staffs are coordinating staff work and projects virtually on a day-to-day basis. NORDEFECO's Vision 2025 is agreed between NORDEFECO nations, and Denmark will work together with Finland, Norway, Iceland and Sweden to achieve the goals. Several goals are directly focused on procurement and are therefore within DALO's area of responsibility. DALO's staff is committed to reaching the goals and the Vision 2025 is reflected in the agendas of our meetings. NORDEFECO has an annually rotating chairmanship in the executive part of the structure, and in 2020 Denmark will have the chairmanship in NORDEFECO. The priority of the chairmanship will be based on the goals from the Vision 2025, and DALO will support these priorities within the Nordic procurement cooperation on different levels.

ESD: In the scope of the so-called European Phased Adaptive Approach of the US

Government, a European naval BMD capability has been suggested to be supported by a sensor upgrade of Danish, Dutch and German frigates. The Netherlands has launched a respective programme; Germany is still considering options. What is Denmark's position?

with the Cardom10 mortar system. In the period between October and December 2019, the last variant of PIR V, command post will be tested in Denmark. With the conclusion of that test all variants of the PIR V will be rolled out in the army. From 2019 to 2023 DALO will receive around



Lt Gen Lentfer visits the F16 Service Life Sustainment Programme (SLSP) in Aalborg.

Lt Gen Lentfer: The declaration of the NATO Summit in Wales in 2014, in which Denmark pledged to contribute to NATO's defence against ballistic missiles with sensor capability, was reaffirmed by the parties in the framework of the current defence agreement signed in 2018.

Regarding a possible naval BMD capability onboard the Danish IVER HUITFELDT class frigates, Denmark is also considering other options. A final recommendation is awaiting further studies to identify flexible options including missiles and sensors. A study including a land-based supplement is also ongoing.

ESD: What is the status of the PIRANHA programme? To what extent are Danish companies involved?

Lt Gen Lentfer: 27 March 2019 was a landmark for the PIRANHA 5 programme. A ceremony between DALO and the Danish Army marked the first handover of the PIRANHA 5 to the army. It was also a programme milestone with a complex test segment including Verification Acceptance Test, User Test, and Climate Acceptance Test HOT and COLD for the basic infantry PIRANHA 5. Until now, following variants besides infantry have been tested: engineer, ambulance (in two different configurations), repair, and mortar. The PIRANHA 5, mortar is equipped

70 PIRANHA 5 each year, bringing the total number of PIRANHAs up to 309 for the Danish Army.

ESD: To what extent are Danish companies involved?

Lt Gen Lentfer: Within just 4 years after contract award, 14 companies are now involved in the execution of the PIRANHA 5 programme. So far, 24 projects have been approved in close cooperation, and under the support of the Danish Business Authority overseeing GDELS' outset requirements. An additional 7 projects involving 5 companies are currently either planned (budgeted) or undergoing the final approval processes by Danish authorities.

The products and services obtained from Danish companies cover a wide range of technologies and capabilities which are deemed relevant for the national security of Denmark; for example, advanced software, cybersecurity, surveillance technology, operational protection of personnel and military equipment etc.

GDELS-MOWAG has involved Danish industry both emerging companies as well as long-established Danish market-leaders in the PIRANHA 5 programme through a broad array of projects, ranging from outsourcing of sub-system production to final assembly and cutting-edge development

projects. Companies include Hydrema, TenCate Advanced Armour Denmark, Nissens, Mikkelsen Electronics, Idoc, Rival and many more.

ESD: In May 2016, Denmark announced the decision to procure 27 F-35 LIGHTNING II for €2.7 billion whereupon Boeing challenged the decision. What is the current situation?

Lt Gen Lentfer: In 2016, the Danish Parliament approved the acquisition of 27 F-35 LIGHTNING II. The fighters will be implemented over a period of six years from 2021-2026. The delivering of the first fighters are to be expected in 2021 at Luke Air Force Base in the US where the Danish pilots will be included in training together with the other F-35 partner countries. The first fighters are expected to arrive at Fighter Wing Skrydstrup in Denmark in 2023.

ESD: How do you assess the capabilities of the Danish defence industrial base? To what extent is the Danish military dependent on foreign suppliers?

Lt Gen Lentfer: Denmark has one of Europe's most flexible and well-functioning labour markets featuring highly skilled and productive workforce and ex-

cellent up and down-scaling conditions for companies.

Although the Danish defence and security industry is a small player globally, it has a number of important positions of strength in, for instance, advanced software, naval platform designs, command and control systems, surveillance and radar technology which, with the increased focus on civilian security and counter-terrorism, are assumed to have pronounced future potential.

However, despite the growing demand and the immediate potential of the Danish defence and security industry, the industry has experienced limited growth. The Danish defence industry is still dominated by a small handful of companies.

For large equipment types, for example armoured vehicles, artillery, lorries and aircraft, Denmark is fully dependent on foreign suppliers as there are no Danish manufactures in these areas. Denmark has, however, a long history in the maritime industry and most Danish maritime vessels are built by Danish shipyards.

ESD: Has the new alignment towards national and Alliance defence had an effect on the Danish defence procurement budget? Do you anticipate the budget to

increase over the next few years? How is this affecting the Danish position in CNAD taking into consideration a replacement for AWACS and the AGS Programme soon-to-be-operational?

Lt Gen Lentfer: The Danish Defence Agreement 2018-2023 and the 2019 amendment represent a substantial increase in defence spending. This increase will be gradually implemented and will reach a total of approx. DKK5Bn in annual investment growth in 2023. Thus, as per 2023 the annual defence spending has increased by 20% compared to 2018 with a significant portion earmarked to capability acquisitions. Consequently, Denmark demonstrates its aim to live up to NATO's guideline of investing 20% of defence budget's on new equipment. The Defence Agreement will strengthen the Danish Defence's contribution to NATO's collective deterrence, improve capacity to contribute to international operations, enhance national security and increase cyber defence as well as the national emergency preparedness. Additionally, Denmark will fulfil assigned responsibilities in the NATO programmes in which we participate.

This interview was conducted by Jürgen Hensel and Bo Leimand.

INTELLIGENCE FOR THE INTELLIGENT

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Tamir Eshel

Operated by, in support of, or teaming up with formations, unmanned machines take missions thought to be too difficult, dangerous or plainly boring. Such missions are relevant for drones, unmanned ground vehicles and unmanned surface or underwater vessels alike.

Unmanned systems are not really unmanned but perform as remotely operated platforms. They often do so under the control of human controllers, where certain parts of the mission are done automatically, enabling the operators to rest or focus on more important tasks. Typically, the ratio is one (or more) human controller per unmanned platform, and many more

employed to sustain and maintain it over long missions.

Unmanned and autonomous machines are designed to be 'smarter' and more agile and self-aware; they can plan a path, identify, and avoid obstacles, perform certain manoeuvres and execute specific mission segments independently when human control is unavailable or not required. Since

The highest level of autonomy is represented by unmanned and autonomous platforms that can perform missions as part of combined teams, that consist of manned and unmanned units. Such teams may be equal or weigh more to the manned or unmanned side. For example, an unmanned scout team supporting a squad or platoon, would require a few drones or UGVs, each operated by a system specialist. Future combat vehicles could be operated with one or more 'robotic wingmen', like fighter pilots operating a combined formation of manned and unmanned wingmen. A different concept may involve a swarm of dozens, or even hundreds of mini-drones, deployed against a target of enemy concentration, with the entire swarm controlled by few operators, a single supervisor or no supervisor at all, preloaded with mission details, target allocation and rules of engagement to guide their mission. This last scenario is the closest to the science fiction doomsday scenario of the Terminator movie series.



Photo: Schiebel

A MUM-T test employing a CAMCOPTER S100 with an H145



Photo: Schiebel

The trials carried out by Airbus Helicopters and Schiebel went up to MUM-T LOI 5.

Mission Autonomy and MUM-T

Remote control of unmanned systems has been with us for decades. In recent years, lightweight portable electronics have introduced ever smaller yet more powerful and sophisticated systems, both in the platform side as well as at the controller. With these advancements, platforms have become more autonomous and capable of assuming more tasks previously done by the human operator. Essential mission phases such as automatic take-off and landing, self-test and mission planning are common today; obstacle detection and avoidance are also becoming a reality, with combined real-time sensing and processing on board the platform, as are more specific mission capabilities such as target revisits, automatic target recognition, tracking, and geolocation. Although the drone, or UGV can perform complete missions by itself, the information it gathers along the mission requires significant analysis that cur-

Author

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many tasks are delegated to the machine, a single operator can control several such semi-autonomous platforms from a single control unit, enabling more efficient, and economic use of resources.

Photo: via author



The US Army's SCORCH programme has been ongoing since 2013; it leverages AI and system autonomy to simultaneously control "intelligent systems" on up to three drones.

rently requires human authority. With artificial intelligence and machine learning implemented, at the control centre and later the platform, the human mission operators become mission analysts, taking a supervisory role to approve or deny the machine's decision support recommendations.

Where unmanned systems are semi-autonomous, and can perform specific tasks following specific orders, they tend to behave like soldiers, and are prepared to join the 'Man-Unmanned Team' (MUM-T).

A trending military capability since the mid-2000s, MUM-T has become an important concept in modern operations, where combat elements employ unmanned systems as part of their operations. While MUM-T do not relate to specific platforms, the most common use is air-air where air crews or

ground elements employ unmanned aerial systems, and ground-air with ground-ground employment of unmanned ground vehicles being tested in operational experiments.

Operating a UAS from a fast-moving platform, such as a helicopter or aircraft, presents several obstacles, particularly with mounting the directional data link on the helicopter.

MUM-T Levels of Interoperability (LOI)

The employment of MUM-T is defined in five LOIs:

Level 1 – Receipt of information from the unmanned platform via its ground control element;

Level 2 – Direct receipt of information from a UAS to a manned helicopter; (via remote terminal);

Level 3 – Manned platform directly controls the payload of the UAS directly;

Level 4 – Manned platform controls the airborne platform & payload, except recovery;

Level 5 – All functions supported in Level 4 plus the ability to take off and recovery of the UAS;

Level-X – Refers to the evolving capability of a single manned platform to control multiple UAX.

The first operational platform to utilise MUM-T was implemented with AH-64D APACHE attack helicopters, converted to operate an MQ-1C GRAY EAGLE drone via a rotor-hub mounted Common datalink. This application supported Level-2 MUM-T, where the pilot or co-pilot in the modified APACHE can receive sensor video streaming from the drone. This datalink can also retransmit full motion video received from the drone, or the APACHE's own TADS/PNVS sight with relevant metadata to another MUM-T equipped APACHE or ground element equipped with One Station Remote Video Terminal (OSRVT).

A more advanced configuration currently in the making is L3's applique for the new and remanufactured AH-64E (ECHO). It provides APACHE aircrews with increased SA and NC interoperability while reducing sensor-to shooter timelines and increased survivability for the gunships.

This new gear expands the Echo to support MUM-T Level 3 and 4, enabling the pilot to control the drone's payloads and flight path. The interface is not limited only to the GRAY EAGLE, as both RQ-7 SHADOW and MQ-11 RAVEN mini-UAS are supported. In fact, the gunship-drone team now assume the role of an armed scout in the US Army aviation brigades, previously done by the OH-58D KIOWA WARRIOR. The MUM-T kit added to the AH-64E includes an upper receiver (UR) mounted on top of the rotor, providing APACHE-GRAY EAGLE UAS (air-air) data link and a lower transceiver unit providing air-to-air-to-ground (AAG) line-of-sight communications that links with low flying SHADOW and RAVENS, and relays video to ground elements. The system employs different links in Ku, C, L and S bands covering both applications. This new capability is slated to become operational next year (2020).

In total, the Army plans to acquire 690 AH-64Es by 2025. The AH-64E is highly mobile, lethal and can destroy armour, personnel and material targets in obscured battlefield conditions at ranges out to 8-kilometers, an Army statement said.

Photo: USMC



The US Marine Corps is testing an interface optimised for controlling unmanned vehicles, sensors and payloads from a single device.

To further expand capabilities the US Army plans to test Rafael Spike NLOS guided missiles with AH-64E. Fired from ranges up to 30 kilometres, Attack helicopters carrying such weapons would greatly benefit from UAS interoperability.

European MUM-T Initiatives

MUM-T capability is not restricted to the US Military. Many other air forces in Europe, Middle East and Australia are actively engaged in research, and experimentation and have formulated acquisition plan for such capabilities. General Atomics Aeronautical Systems (GA-ASI), the manufacturer of the MQ-9 REAPER and PREDATOR XP have pitched this capability for the international market since 2017, introducing MUM-T capabilities with its export-oriented PREDATOR XP drone. In its marketing, GA-ASI featured increased survivability for the manned platforms, faster target engagement with long range engagements and more efficient battle command, based on fresh information obtained via the drones.

L3 has also emphasised their MUM-T capabilities as featured in the AH-64 manned helicopter platform, MQ-8 GRAY EAGLES, SHADOW and RAVEN UAS. According to the company, the technology can be optimised for other airborne assets used by NATO and international partners.

In 2018, Airbus became the first European helicopter manufacturer to demonstrate this technology with the highest level of interoperability. The tests held in Austria employed an Airbus H145 specially equipped and integrated with datalink and UAS control application, and a standard Schiebel S-100 CAMCOPTER. On its announcement Airbus placed a unique argument. "By controlling drones from the air, military and parapublic crews can explore tough-to-access areas and significantly expand observational capacities." Airbus said, UAS can not only enlarge search areas but also access areas that a helicopter might find difficult. They are able to explore unknown territory and deliver information to the helicopter crew, which can then step in with the helicopter's superior effects. Testing and certification are currently focused on military uses, but MUM-T has the potential to benefit a wide range of sectors and enable faster and more cost-effective mission completion.

On this test the drone was controlled and piloted by a third operator in the helicopter. The trials carried out by Airbus Helicopters and Schiebel went up to MUM-T LOI 5. This allows the manned platform to exercise full control of the UAS including its take-off and landing. LOI 1, the lowest level, is the indirect receipt and /or transmission of sensor data obtained by the UAS to the manned aircraft. Airbus considers operations by a third crewmember for parapublic missions (law enforcement and search and rescue) while military missions would reduce the crew to two persons.

The S-100 mission planning and control system was provided by Schiebel. The next step will be to optimise the human machine interface based on a thorough analysis of the crew workload using the results of the flight tests.

In 2018, the German Army has also experimented with MUM-T technology. During a recent flight demonstration a pilot controlled an UMS SKELDAR helicopter drone while flying a helicopter specially equipped with MUM-T mission equipment provided by ESG. The test flights verified the capability of a UAV teaming with the manned helicopter, controlled as an unmanned wingman on a command basis. An important part of the test involved automated mission planning. Missions included the provision of reconnaissance data from a location, exploration of forest perimeters between positions and the clarification of possible landing zones for the helicopter. These highly complex tasks were only possible thanks to the high degree of automation of systems in the unmanned UMAT platform, including route, sensor and data link management. The route plan-



MUM-T OPERATIONS

Manned Unmanned Teaming
LEVEL 5 INTEROPERABILITY

CAMCOPTER® S-100
UNMANNED AIR SYSTEM

Photo: UMS Skeldar



At a flight demonstration in 2018, a pilot controlled an UMS SKELDAR helicopter drone while flying a helicopter equipped with MUM-T equipment provided by ESG.

ning took place, for example, considering threats, flight areas, sensor characteristics and data link coverage. The demonstration flights were carried out under project MiDEA (mission monitoring by drones for reconnaissance), part of the ESG MUM-T (Manned-Unmanned-Teaming) program and VTOL-UAS technology roadmap. Another MUM-T demonstration was carried out in the UK by QinetiQ. This experiment featured Search and Rescue (SAR) missions augmented by drones. On this mission, the drone performed missions off the coast of Wales. While the drone was Flown under the control of forward ground control centre, its sensors were controlled by the Maritime Coastguard Agency (MCA) control centre, located 200 miles away from the site. The live situational awareness feed, which included marked up imagery, search status and reference points was simultaneously distributed to multiple teams at the

search site in Llanbedr, and to remote sites in Fareham, London and Southampton.

Future MUM-T Initiatives in the US Army

The US Army Future Vertical Lift Cross-Functional Team (FVL CFT) is exploring various concepts of manned-unmanned teaming for a range of missions and the helicopters currently being evaluated for future procurement are expected to field with MUM-T capabilities.

US helicopter manufacturers exploring MUM-T capabilities with current and future platforms include Sikorsky, Boeing and Bell. Sikorsky explores various helicopter autonomy capabilities through the Aircrew Labor In cockpit Automation System (ALIAS) programme managed by DARPA. ALIAS provides different autonomy functions assisting the crew by reducing workload, up to the

level of removing the entire crew from the aircraft. The programme provides for optionally piloted systems that would eventually enable the integration of manned/unmanned teams with existing UH-60 helicopters.

For example, Bell has unveiled an unmanned version of its V-280 VALOR tilt rotor aircraft, that could be operated as an unmanned wingman. The V-247 VIGILANTE will be able to access areas too dangerous for manned platforms and perform as a gunship suppressing and securing landing zones for manned platforms.

The LOI levels depict the procedures remote operators can do with an unmanned platform, and the functions allowed for them to follow. The drone's ability to maintain contact with targets even at high threat situation is critical for the warfighter, enabling the manned platform to stay beyond line of sight yet maintain continuous coverage of the target. Several platforms may be used to persistently cover an area of interest from different sides and distances, designate targets and help direct guided weapons or indirect attack (mortar or artillery) to suppress the enemy and enable friendly operations in the contested area. Using tried and tested combined arms methods enhanced with MUM-T capabilities, these activities can be performed today with small UAS, even without the use of the larger drone's armed reconnaissance capability.

The Network Enabler

Nevertheless, as such operations rely on extensive use of datalinks, operating multiple drones in a small airspace could be challenging. While larger drones rely on datalinks that have robust electronic counter-countermeasures and mission endurance that can outlast enemy jamming, the small UAS that often use lower level of communications security may be more vulnerable

Photo: Capt. Brian Harris, US Army



A US Army APACHE equipped with air-air and air-ground datalinks for advanced MUM-T applications

to electronic interference and attack. With robotics and UAX becoming commonplace in the future battlespace, a dedicated network laying the infrastructure for command, control and communications of UAX is mandatory. Such a network would likely be a MANET type network that will expand and enhance resilience and data transfer capacity as more and more nodes join the network. Other networks may rely on low-earth orbit satellite constellations, enabling the manned and unmanned systems to use SATCOM datalinks that are more difficult to jam. Such networks will also prove more capable of supporting operations in urban, forested or RF-contested terrain.

The US Air Force explores such a network with the Mobile Unmanned Air Vehicle Distributed Lethality Airborne Network (MUDLAN). Currently under Joint Technical Capability Demonstration (JCTD) status, MUDLAN is expected to transition to the Air Force and Combat Commands by 2020. This network will support high data rate communications across multiple airborne and surface platforms and is designed to continue operating under electronic attack. With spectrum agility, MUDLAN can autonomously shift frequency bands to ensure continuous air, land, and sea connectivity in contested electronic warfare environments. Initial flight tests of the network nodes are scheduled this year, and demonstrate over-the-horizon, distributed communications capabilities.

Human-Machine Interfaces

Unlike a remote controller back in the Ground Control Centre, dedicated to operating and control the unmanned system and its payloads, the combatant participating in a MUM-T has many tasks, and the unmanned system is just part of those responsibilities. Therefore, the integration of MUM-T human-machine interface (HMI) is far more challenging than that of the common GCS.

Part of the solution is the Army's standard One System Remote Video Terminal (OSRVT), developed by Textron Systems as a tool used by ground operators to receive video from airborne assets. Today, it is integrated into helicopters, or other platforms, to deliver full-motion video to the crew.

Employed with MUM-T OSRVT communicates through a ROVER 6 modem, multi-band radio frequency equipment, and a directional antenna capable of relaying multiple video streams back to the command centre.

Originally employed with ground elements, OSRVT also provides real time information to ground forces aboard a UH-60 Black-



Photo: SNC KUTTA TECH

The company SNC Subsidiary Kutta Technology developed a toolkit enabling the remote crew to take "supervised usage" (LOI-4) control of multiple UAS.

hawk or CH-47 Chinook en route to an objective during an air assault mission. Such terminals provide aircrews with real time video of the landing/pick-up zone (LZ/PZ) long before their arrival. The troops disembarking from the helicopter can use the same terminal to obtain live motion video from UAS. With the current software version, the terminal provides user full control of the remote EO payload.

The Army plans to extend MUM-T by enabling an air crew to simultaneously tap several video and sensor feeds from different platforms in real-time. This capability is supported by a new system called 'Supervisory Controller for Optimal Role Allocation for Cueing of Human Operators' (SCORCH). This programme has been ongoing since 2013, leverages AI and system autonomy to simultaneously control 'intelligent systems' on up to three drones. The interface was optimised for multiple UAS control, and features a glass cockpit with touchscreen interaction, a movable game-type hand controller with its own touchscreen display, an aided target recognition system, and other advanced features.

SNC Subsidiary Kutta Technology took this approach by enhancing the OSRVT into a bi-directional remote video terminal. The company also developed a toolkit enabling the remote crew to take "supervised usage" (LOI-4) control of multiple UAS. This system can be installed and operated from the standard cockpit displays or from a compact terminal configured as a wearable keypad, enabling any crewmember on

any platform equipped to operate MUM-T functions. The system offers advanced functions for pre-planning and multi-UAS missions, delegate mission phases to different vehicles. Users can define 'start at' or 'start from' commands at certain phases, rather than control the drone or sensor to reach a certain line of sight. Remote operators can assign targets, order a vehicle to engage or disengage auto-tracking, assign a payload to 'follow the dot' thus keep looking over a moving vehicle, or look ahead and along a flight path to secure a route or support troops. These functions help the crew manage activities and tasks while maintaining cognitive awareness and workload in flight and in combat.

Summary

With growing autonomy, smarter unmanned systems, empowered by AI and mission automation, are better able to adapt to higher levels of human-machine teaming, taking future MUM-T operators to new heights. Such capabilities will become critical in employing large groups of UAS, in swarms or flocks, where drone will get, collaborate on, and fulfil mission commands under human supervision without the need to receive specific instructions. This approach would enable future military forces reduce manpower while increasing combat capabilities, keep the human warfighter out of immediate danger, and leave the human operator bandwidth and attention to manage the overall mission. ■

Fragmented Efforts

European Multi-Role / Combat Helicopter Acquisitions

Georg Mader

There are several signs that the reliable post-Cold War order characterised by rule-based decision-making is slowly eroding. This is coupled with geopolitical changes and ongoing war in the Middle East or Ukraine and growing environmental uncertainty.

These are the key catalysts driving a significant increase in global defence spending. Combat helicopters have received a fair share of capabilities assessment, with a focus on fleet renewal mostly by replacement, but in some cases also upgrade of ageing equipment. Nonetheless, European fleets remain surprisingly old and, despite repeated calls for joint acquisition initiatives, there still is no coherence in who acquires what from European or US manufacturers. As there is almost no procurement of full-fledged attack helicopters, this article is about several ongoing weaponised multi-role combat-helicopter acquisitions.

Nothing compares in dimension and scale to the US Army's Future Vertical Lift (FVL) programme and the innovative concepts of its contenders. The US military rotary-wing community continues to demand greater reach, connectivity, protection, reliability and overall combat effectiveness, underpinned with realistic and in the long run cost-saving training solutions (which nevertheless have to be paid for upfront). It is encouraging that in the last decade, industry works more closely with defence forces and focusses on technological requirements where most needed and with the MoD's acquisition authorities to understand their priorities. However, affordability will always be the crucial factor. In most MTOW-categories there are several attractive options for those who want the broad utility offered by rotary-wing operations and light- and medium-lift with armed options. And industry – more or less – has responded by introducing or preparing better information management to reduce cockpit-workload, innovative airframe and rotor solutions, along with more

Photo: Georg Mader



A demonstration of a mixed helicopter assault in Zeltweg, Austria

powerful and fuel-efficient engines. Or – like AIRBUS has demonstrated with Austrian SCHIEBEL – new innovations like manned-unmanned teaming.

A Hard Turn Every Few Years?

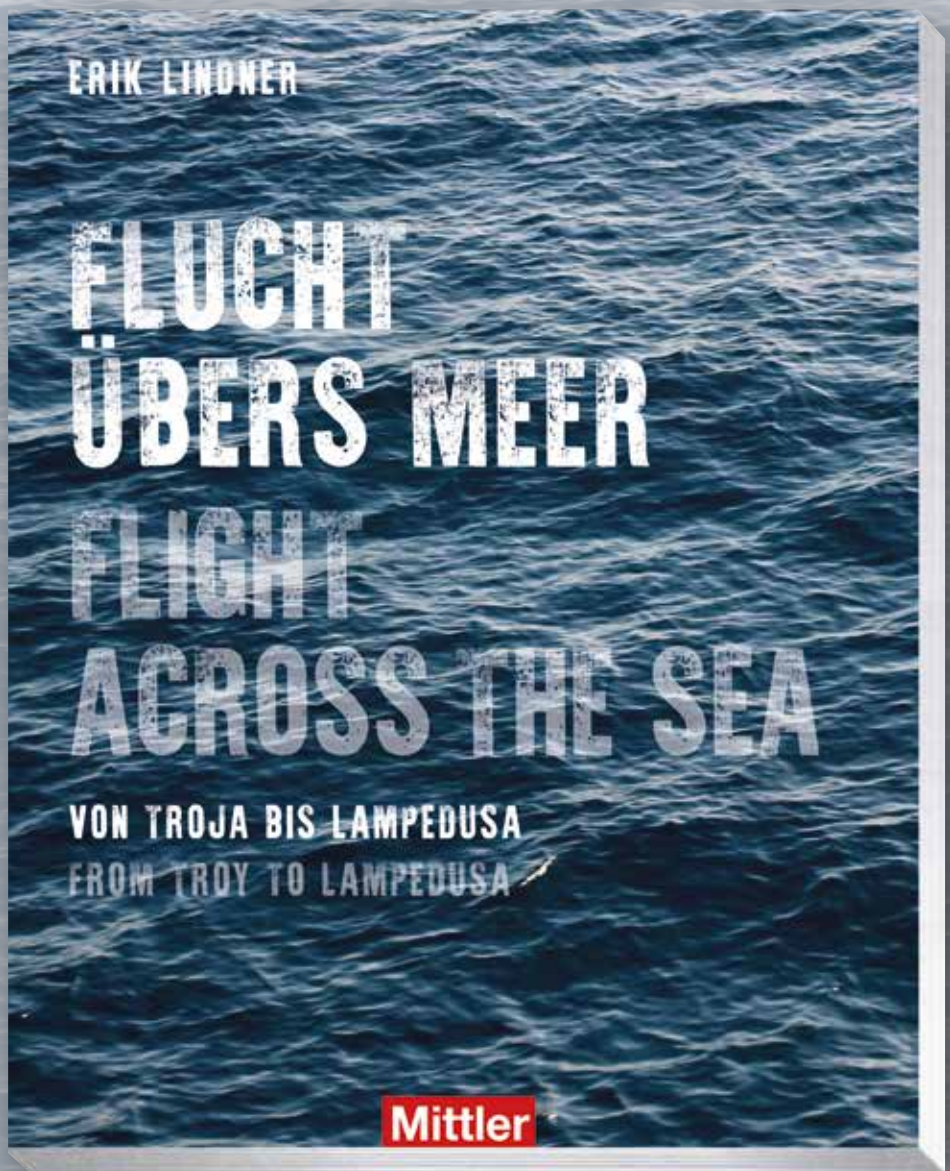
In order to hedge against the withdrawal of the US, it is now a common notion that Europeans should "assume a greater share of the burden of defending Europe", with the emphasis on capabilities and operational commitments, and not only on – never satisfactory – budgets. But there is little consensus as to how or why they should do so. This lack of consensus also holds for the political level. A few years ago, a high-ranking UAE-AF officer questioned the wisdom of our military procurement culture, saying: "Why on earth do you follow the promises of some "Messiah" every four or five years, which are then only turned upside down and waste a lot of money and time? How can you successfully complete expensive long-term project goals, such as acquisitions and the introduction of completely

new fleets, when these programmes suffer a sharp bend every few years? This is madness!"

Well, the man has obviously seen our ESD "Spotlights" because in our survey below, one can find several examples of such sudden bends or even total freezings following national elections and changes in governments. Nevertheless, with European MR/CH fleets currently highly fragmented and ageing, there is an ongoing trend towards rationalisation by reduction of the platform numbers present in a number of member states. As maintenance costs are rising with airframe-ages, countries are increasingly looking for opportunities to ensure more efficient and economical ways of maintaining or adapting their capabilities. All this, and the return of a focus on defence and security in European policy and a noticeable will to invest more strongly in military capabilities may lead to greater activity when it comes to developing European MR/CH capabilities. Additional financial incentives may encourage multinational collaboration through EU-level funds like the European Defence Fund (EDF).

Author

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RAND's Findings

In September 2018, the European Defence Agency (EDA) commissioned RAND Europe to conduct a study on potential collaboration opportunities amongst EDA participating member states (pMS), specifically in regard to light and medium multirole/combat helicopters (MR/CHs). The goal of the study was to support the EDA in identifying collaboration opportunities throughout the MR/CH life cycle and to analyse the possible costs, benefits and challenges of each opportunity. For the purpose of the study, the 'light' and 'medium' categories were defined based primarily on the European Aviation Safety Agency's (EASA) classifications. However, the MTOW of medium helicopters was expanded from 9 tonnes (as defined by EASA) to 11 tonnes, in order to include slightly heavier multirole helicopters, such as the NH90 and UH-60 BLACK HAWK and in order to align with the classification of what would be most useful to the EDA and its pMS.

The study was recently released, and one of its key findings is that the European MR/CH landscape is highly fragmented and ageing, hindering both operational effectiveness and cost efficiency. On paper, the EDAs members operate approximately 20% of the global MR/CH fleet (~2,270 helicopters), but they operate 30 different platforms, with France being by far the largest MR/CH owner in Europe with almost 500 helicopters. France is followed by Italy, the UK and Germany with fleets ranging between 212 and 274 rotorcraft. However, most European countries have smaller fleets of 60 units or less. Individually, European member states in numbers also lag behind countries such as India, China and of course the US. And their fleets are ageing: Some 20% of the current military (weaponised) combat-capable MR/CH fleets were first introduced in the 1960s (like the Austrian ALOUETTE-III



Photo: Bell-Textron

An armament proposal for the Bell-429 GLOBAL RANGER

from 1967 on), 33% in 1970s, 13% in the 1980s, 15% in the 1990s and only 3% in the 2010s. The oldest helicopters are four of the five most represented types in terms of the total European fleets: the Bell 206, the Airbus H215 SUPER PUMA, the Bell 212/412 and Aérospatiale's GAZELLE, yet still the mentioned predecessor ALOUETTE.

Counting on US Hardware

In 2018, the US DoD began putting its surplus fleet of AH-1W SUPER COBRAs – called WHISKY COBRA – up for sale onto the international arms market. Like the succeeding AH-1Z VIPER, both trace their roots directly to the iconic UH-1 IROQUOIS/HUEY. The USMC's transition from AH-1W to AH-1Z should be complete sometime in 2020; in the end only 37 AH-1Ws were reworked into AH-1Zs and that effort ended in 2014. As such, there is a large fleet of WHISKYs that could potentially be sold off as surplus to a foreign buyer, or donated via FMS initiatives. Of course any sale has to be approved by the US State Department. Surplus AH-1Ws hitting the market are joined by many out-

phased OH-58D KIOWA WARRIOR armed scout helicopters, which are also being exported to Croatia or Greece, for example, as surplus, after the US Army retired the type. This is to the chagrin of manufacturers who see flooding the market with affordable used airframes as detrimental to their business. Both cheap and upgradable types are denting BELL's looming export success of the UH-1Y/AH-1Z family of helicopters. Cash-strapped Eastern European militaries could move toward acquiring upgraded AH-1W for at least part of their attack helicopter needs. Smaller countries – like the Baltic States – could even acquire these helicopters to build up their anti-armour defences against a potential Russian incursion. And smaller countries are accounting for most of the recent recent or ongoing European acquisition/replacement activities:

Albania is to receive three second-hand Sikorsky UH-60 BLACK HAWK, as defence minister Olta Xhaka announced on 8 April. The acquisition will be part of a US military aid package for Tirana that was signed during her visit to the US. Xhaka noted that "they are in good condition and will enhance Albania's military capabilities and modernise the country's air force."

On 7 May 2019, the US State Department approved deals which might equip the Czech Republic with BELL UH-1Y/AH-1Z VENOM/VIPER or Sikorsky UH-60M BLACK HAWK helicopters. A possible FMS contract with Prague could involve anything between an initial four AH-1Zs and/or 12 UH-60Ms, to replace their ageing 16 Mi-24V/Mi-35s. Such acquisitions would cost between US\$205M and US\$1Bn, including weapons, training and in-service support. BELL's proposal involves a mixed fleet, that includes eight UH-1Y armed utility helicopters. Armaments proposed for the AH-1Z include the LM AGM-114 HELLFIRE ASM and a nose-mounted 20mm cannon, while

Photo: Georg Mader



Two Czech Mi-24Vs

the UH-60M would feature BAE Systems AWPKS-guided HYDRA rockets and machine guns. If coming into effect, Prague would become the third FMS customer for the UH-1Y/AH-1Z (after Bahrain and Pakistan), but first in NATO to fly the updated HUEY/COBRA. A year ago, an earlier sale of 12 UH-1Y was approved, but the deal has been held in limbo by the incoming Babis administration. BELL completed production for the USMC last year, with no export orders yet secured for the type.

On 22 August, Czech Prime-Minister Andrej Babiš and Defence-Minister Lubomir Metnar visited the 22nd (helicopter) base at Náměšť, where Babiš commented on the renewal of the Czech rotory-fleet: "I was acquainted in detail with the acquisition of new helicopters. It should be four battle and eight transport modern machines. Soldiers need them. We want to make the purchase as soon as possible. Deliveries should start in 2023."

Meanwhile, LEONARDO still competes for the Czech requirement with its AW139M, offering these for just US\$356.5M. Of course there is the argument that the AW-139M is a militarised variant of a civilian helicopter which, however, holds true for almost all helicopters in this segment. And while the

UH-1, AH-1 and UH-60 are iconic military machines, none of them fully answers (not only the) Czech requirements: UH-1Y has no ATGMs to destroy armoured targets with missiles, while AH-1Z is not a multi-purpose helicopter and will not provide SAR, CSAR, CASEVAC, air transport of personnel and material or tactical airborne insertions; it can hardly cooperate with national Integrated Rescue Systems. And the UH-60 is not really known for attack or heavy escort duties, nor does the AW139 come with a rotor anti-icing system, unlike the UH-1Y. And it also has to be remarked, that the US are offering to (not only) the Czech Republic helicopters by US OEMs, while they themselves have selected LEONARDO-US' MH-139, to replace the USAF's UH-1N HUEYs.

Greece is considering the procurement of the LM MH-60R ROMEO SEAHAWK maritime armed multimission helicopter to augment and replace current platforms, as the country's government announced this February. The Hellenic Navy is looking at acquiring up to seven MH-60Rs to augment its 11 Sikorsky S-70B-6 AEGEAN HAWK helicopters and replace seven Agusta-Bell AB-212 anti-submarine warfare (ASW) helicopters that are still in service but reaching their retirement date. The helicopters would

be bought under the FMS programme and were cleared for Greece in July 2019, but the US\$600M procurement has first to be signed off by the Defence and the Government Council for Foreign Affairs and Defence, before a contract can be signed. The ROMEOs would be armed with torpedoes, 12.7mm GAU-21 (M3M) and 7.62mm M240 (FN MAG) machine guns, AGM-114 HELLFIRE laser-guided missiles, and BAE's APKWS' laser-guided 70mm rockets. They would also carry the Thales/Raytheon AQS-22 airborne low-frequency sonar.

On top of that, Greece – while still having to maintain the fiscal targets agreed upon with its European lenders – is the most active receiver of surplus US rotory platforms. Only 16 months after having submitted a letter in this regard to the US, in June 2019 Greece received 70 surplus BELL OH-58D KIOWA WARRIOR armed reconnaissance helicopters; 36 are operational, 24 for training and 10 for spares. In early 2017, Croatia has acquired 16 similar choppers, the latter somewhat hampered by thin US-Army documentation-records.

The AIRBUS H225M (CARACAL) was originally intended to be Poland's replacement for all services, but in October 2016 the former government scrapped a deal to buy 50 for

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An Italian Leonardo AW149



A Bell UH-1Y

both air force and navy use. The updated “Technical Modernisation Plan 2017-2026” still lists the KRUK project to replace the Polish fleet of 1970s-vintage Mi-24 HIND assault platforms with new-build attack helicopters. Allegedly, the 24 to 36 KRUK attack helicopters might now be postponed or become part of a new technological modernisation programme. Next to the Mi-24D/Vs which are earmarked for an upgrade, the replacement of the Mi-2- and Mi-8/17 fleets is pending as well. Thus far, the only progress made was a contract to Sikorsky’s PZL Mielec facility concerning delivery of four S-70i BLACK HAWK helicopters for the Polish SOF. This includes retrofitting airframes plus logistic and training packages. The total value of the contract is €157M and, according to Defence Minister Mariusz Błaszczak, the helicopters are to be delivered by the end of this year. Regarding naval/ASW helicopters to replace the Polish Mi-14PL and –PS and the spare-parts-critical SH-2G SUPER SEASPRITES, LEONARDO – having a presence in Poland via its PZL-Świdnik subsidiary – with its AW101 was the only bidder in April 2018 as AIRBUS withdrew from the competition, citing demanding offset requirements for the programme against only four platforms. This April, Warsaw’s MoD signed the deal for €380M, again with PZL as the prime contractor. Delivery of the AW101s to a naval unit on Poland’s Baltic coast is scheduled for 2022. At Farnborough 2018, Romania announced to significantly improve its rotory power by buying 21 Bell UH-1Y VENOM and 24 AH-1Z VIPER multi-role/attack helicopters. As the

contenders AIRBUS and SIKORSKY have highlighted, neither has the programme been officially announced, nor has a public tender been put forward. At present, it is only known that no contract has been signed between the Romanian government and BELL, though there are ongoing negotiations between the latter and IAR Ghimbav (Bună ziua Braşov), whether parts of this order should be produced locally. Back in 2017, the government has signalled that it will acquire at least four H215Ms from AIRBUS to be produced at IAR Ghimbav. Meanwhile, a latest version of the domestic-built Romanian IAR330 (SA.330 PUMA) is designated IAR-330L-SAR. Four helicopters of the 57th Squadron from Mihail Kogălniceanu were upgraded to this standard over the course of two years at IAR Brasov. Apart from the BriteNite IR system, they had installed sand filters, air conditioning system, bubble windows on each side sliding door, a long range comms system (wire antenna along the left side of the tail boom), a winch and IR floodlight on the right side, a protective cover on top of the main rotor and door mounts on both sides for DShKM heavy MG. The four choppers and 120 personnel will support the UN operation in Mali, starting in mid-October 2019 and lasting for a year.

Counting on European Solutions

When it comes to the long overdue replacement of Austria’s remaining 21 ALOUETTE IIIs, observers expect a 2:1 selection in favour

of European types – if it only would ever get that far. Following the demise of the popular centre-right government in the wake of a scandal about a corruption-rant video, a government staffed by technocrats merely administers the country until snap elections on 29 September will produce a new coalition government which means that nothing will be decided until next spring. Back in August 2018, it was announced that up to €400M additional funding had been added to the agreed government budget, to launch the long-delayed rotory replacement. Former Defence Minister Mario Kunasek said that before the end of last year, his air materiel staff would publish an RFP for 12 light and medium multirole and optionally armed helicopters, with a maximum take-off weight of 3 to 5 tonnes and for six lighter training helicopters, for which manufacturers are expected to offer combined bids. Deliveries were targeted from 2022 on. But neither the funds nor the procurement process ever materialised. Requirements, however, are for a twin-engine craft with full IFR-cockpit, preferably skids and the possibility of arming them with guns/cannons and rocket launchers. Despite some political squabbling to exclude AIRBUS – for reasons related to the Austrian EUROFIGHTER acquisition in 2003 and a 2017 lawsuit against former EADS which now looks stalled) – AIRBUS Helicopters is expected to bid with the H145M (H125/135 for the trainer), LEONARDO with between the AW109M TREKKER up to AW169M (and possibly AW009) and BELL-TEXTRON with a yet to materialise militarised version of the Bell-429 GLOBAL RANGER (and six Bell 407s or 505s). What is going forward, however, is that three second-hand UH-60A or-L BLACK HAWK helicopters have been added to the Austrian nine S-70A42s (UH-60L). The first of these nine is currently undergoing a full cockpit- and communications-suite upgrade at ‘Ace Aeronautics/Global Aviation Solutions’ in Huntsville, Alabama, and will return home in late 2019. Work on the eight others is contracted to happen at their home base in Langenlebarn. Other than that, 23 AB-212s have received a cockpit-upgrade, NVGs and self-protection, but suffer from crew-shortages. Neighbouring Hungary meanwhile has turned to AIRBUS for fresh procurement, while keeping in service 12 HINDs (six Mi-24V and six ex-GDR-AF Mi-24P for “Pushka” = cannon) which were recently overhauled in St. Petersburg. They are part of the 2018-launched “Zrínyi 2026” defence programme, in which Budapest pledged to steadily increase defence spending (2019: US\$1.8Bn) and to reach the NATO-required 2% of GDP by 2026. In late 2018, AIRBUS



Photo: Mader

Study of a MD969 combat helicopter

Photo: MoD Spain

A Spanish TIGER helicopter

announced that Hungary had placed an order for 16 H225M SUPER PUMA multi-purpose helicopters, equipped with the company's HFORCE modular weapon system, which allows operators to choose between three variants of armaments. Those aircraft will team with the lighter 20 H145M utility helicopters with Helionix digital avionics suite, that Hungary ordered from AIRBUS in June 2018. They also are equipped with HFORCE, including IR-guided AtA and laser-guided AtG missiles, 12,7mm and 20mm MG/cannon-pods and guided/unguided 70mm missiles. The order has a value of €270M. In late June 2019, Airbus has begun the assembly of the first helicopter for the Hungarian Forces at its Donauwörth plant. In 2018, Luxembourg's small army ordered two Airbus H145M helicopters, which will be operational by 1 January 2020. They were purchased to strengthen the aerial fleet of Luxembourg's army and boost the country's involvement with NATO. Luxembourg's contract foresees not only the helicopters itself, but also supply of specific tools, spare parts, and training of 10 pilots. The type comes with a capacity of max. 11 passengers and at a price of €12M. While it has to be remarked, that prices in general are hardly comparable, due to customer-

specifications, equipment, now common multi-years support-packages or simulators. Serbia – while in the fixed-wing/fighter-segment further sticks with Russia – in March acquired three AIRBUS H215 SUPER PUMAs, to be delivered in 2021 and 2022. This order follows a 2016 contract between Serbia and AIRBUS for nine H145Ms, with deliveries under way. Belgrade seeks to maintain good relations with the US, its allies and Moscow, while retaining its military independence. It has been rebuilding its air-capabilities since the country's air force was largely destroyed during NATO's air campaign in 1999. And like Poland and Hungary, Russian platforms continue, with a planned delivery this year of three Mi-35s and two Mi-17V5s. On the other hand, work is being done to turn a military aeronautical plant in Batajnica into an AIRBUS-certified regional maintenance, repair and overhaul centre for SA.341/342 GAZELLES, operated by the armies of a number of countries in eastern Europe including Bosnia and Herzegovina, Montenegro – and of course Serbia itself. When it comes to Scandinavia, in October 2018 the Office of the Norwegian Auditor General Per-Kristian Foss attributed ongoing problems with the helicopter procurement programme to both the original equipment

manufacturer, NHIndustries (NHI), and to the Norwegian MoD: "NHI obviously bears responsibility for delays. At the same time, important prerequisites for the acquisition have not been followed up well enough on the Norwegian side." Neighbouring Finland, Norway, and Sweden selected the NH90 in 2001 to satisfy the requirements of their Nordic Standard Helicopter Project (NH90 Tactical Troop Transport [TTT]). Norway ordered 14 NH90 NATO Frigate Helicopters (NFHs), which were supposed to have all been received by 2008 but by 2018 only six interim 'Step A'-configured (without weaponry and sensors for the anti-submarine warfare or anti-surface warfare roles) and two final 'Step B'-configured helicopters have been handed over. When asked in 2018 if it was satisfied with the NH90 programme, the Norwegian MoD told the media, "We are many years behind schedule, so the answer is no." Retrofits of the 'Step A' platforms to 'Step B' standard will run alongside continued deliveries of new ones, through to the declaration of full-operating capability (FOC) in 2022.

Aside from a few potential acquisitions of the abovementioned AH-1Zs, no European country is considering procurement of genuine two-seat attack helicopters. However, in late 2018, the Organisation for Joint Armament Co-operation (OCCAR), acting on behalf of the French, German and Spanish procurement authorities, has awarded a de-risking study to a European consortium comprising AIRBUS, THALES and MDBA for a mid-life upgrade (MLU) of the TIGER to the Mk 3 standard. France, Germany and Spain will jointly prepare the development of new features and identify innovations needed to improve the TIGER's survivability and keep it operational beyond 2040. For THALES, this is an opportunity to propose the latest-generation interactive cockpit and the upgraded TopOwl-HMD. Some 178 TIGER attack helicopters have been delivered to France, Germany, Spain and Australia – with the latter recently kicking-off a procurement to replace them. BELL and BOEING are already gearing up for an upcoming tender.

A propos France: Paris has advanced by 12 months the launch of its tri-service helicopter 'interarmées léger' (HIL) programme, enabling first delivery of up to 169 brand-new AIRBUS H160M in 2026. Originally, launching this rotorcraft renewal effort which will replace five types with just one was planned for 2022. The 6,5 tonnes H160M will be known as GUEPARD or CHEETAH and will perform missions including reconnaissance, fire support, infiltration of special forces, anti-shiping and (lower/slower) airspace protection. Under current plans, 80 helicopters are for Army aviation, 49 for the Navy and 40 for the French Air Force. ■

Trends in SAM Technology

Doug Richardson

Traditional designs like liquid or solid-propellant rocket motors are still relevant today but they have been joined by more recent technological trends. This article describes some of these trends.

When the surface-to-air missile (SAM) first entered service on a large scale during the 1950s and 1970s, most used trainable launchers that allowed them to begin flight at a suitable azimuth and elevation. Liquid or solid-propellant rocket motors were the powerplant of choice for most design teams, but some opted for air-breathing ramjets. Steering was accomplished using aerodynamic control surfaces. Long and medium-range missiles used command guidance or semi-active radar guidance, while the short-range types often relied on command guidance, semi-automatic command-to-line-of-sight (SACLOS) guidance, or passive infrared homing. While these traditional design solutions are still relevant today, they have been joined by a number of more recent technological trends. This article will describe some of these trends, and give examples (mostly taken from land-based SAM systems) of their use.

SACLOS Guidance

Many examples from latest generation of weapons show that less use is being made of command and semi-automatic command to line-of-sight (SACLOS guidance). Both schemes minimise the complexity of the missile, and remove the need for a nose-mounted seeker. In the former Soviet Union, command guidance was used in many first-generation SAM systems such as the S-75 (SA-2 GUIDELINE) and S-125 (SA-3 GOA), and was also adopted for the S-300P series (SA-10 GROWLER), the first versions of this family of long-range SAMs. China's KS-1/ KS-1A (HQ-12) SAM system is based on the upper stage of that country's HQ-1 locally-developed version of the Soviet-era S-75, and retained command guidance.

Author

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MBDA's LAND CEPTOR uses a missile that combines vertical launch with inertial mid-course guidance and an infrared seeker.

The last major medium-range missile to use command guidance was India's AKASH. The 3M9 missile from the Tikhomirov Instrument Research Institute's KUB (SA-6 GAINFUL) on which AKASH was based uses semi-active radar homing via a nose-mounted semi-active radar seeker. However, AKASH uses digitally-encoded command guidance, and has no seeker. This is likely to change; the current missile has a maximum range of 30 km, but a planned longer-range version already under test will have a nose-mounted seeker intended to increase accuracy. India's Command guidance is still used for some short-range SAMs. Almaz-Antei used a radar-based command guidance when it developed the Tor (SA-15 GAUNTLET), and India's DRDO opted to use seeker-based guidance for its new Quick Reaction Surface-to-Air Missile (QRSAM), which is currently undergoing trials.

Ramjet Propulsion

In the 1950s and 1960s, some SAM design teams adopted ramjet propulsion, but this class of powerplant has now fallen from favour, and most recent designs use solid-

propellant rocket motors. AKASH is the only recent example of an air-breathing SAM. Although developed in the 1980s and 1990s, it is based on the late 1960s/early 1970s ramjet-powered 3M9-series missiles used by the KUB.

Widely used by late 1960s/early 1970s short-range SAM systems such as the BAC RAPIER, Thomson-CSF CROTALE and Euromissile ROLAND, semi-active command to line-of-sight (SACLOS) guidance uses a sensor would detect any deviation between the missile's flight path and the line-of-sight to the target, and then sends the radio commands needed to steer the missile back onto the line-of-sight. SACLOS guidance is still being used by some modern SAM systems. Although such of the equipment carried by the tracked launch platform for South Korea's CHUNG MA (PEGASUS) was provided by what was then Thomson CSF AIRSY, and is near-identical to the equivalent parts of the CROTALE NG system, the 86 kg missile is of South Korean SACLOS design. The Saab Bofors Dynamics RBS 23 Bofors Advanced Medium-Range Surface-to-Air Evaluation (BAMSE) air defence missile system has seen only limited service. It is known to use what its developer



Photo: Max Smith

Despite its age, command guidance is still being used in missiles such as China's KS-1 medium-range SAM.



Photo: DRDO

For its short-range QRSAM missile - seen here making its sixth test flight - India's DRDO has opted to use a nose-mounted seeker, reported to be an active-radar sensor operating in X-band.

calls an Automatic Command-to-Line-Of-Sight (ACLOS) missile. The 2K22/2K22M TUNGUSKA gun/missile system is another SACLOS application.

The S-300P was a landmark system for Russia's air defences, being the first SAM system to use solid-state electronics and a phased-array radar system. As the system evolved, it exploited advances in SAM technology, including vertical launch. The FAKEL 5V55K missile developed for the S-

300P and the shipboard S-300F systems used a cold-launch technique in which the missile was ejected from its sealed cylindrical container-launcher by a gas generator. When the missile reached a height of about 25-30 m, its solid-propellant rocket motor was ignited.

Vertical launch is also applicable to medium-range and even short-range SAM systems. China's HQ-16 medium-range SAM system uses a missile similar in appearance

to the 9M38 missile used in Russia's BUK (SA-17 GADFLY), but although the latter system uses a TEL with a trainable launcher, the HQ-16 carries its missiles in a six-round vertical launcher. The same missile is also carried in the six-round vertical launcher used by Long March International's LY-80. In its original form, the TOR (SA-15 GAUNTLET) vehicle mounted short-range SAM system used eight 9M330 or 9M331 missiles mounted in an eight-round vertical launcher. The TOR-M2 version uses the smaller 9M338 missile, so its launcher is able to carry 16 ready-to-fire rounds. The new 9K331E TOR-E2 version of the system was the first to use the 9M338KE, an improved missile that has increased the maximum range to 16 km. First fielded around 2015, Russia's Almaz-Antey MORFEI system is a mobile point-defence system. Mounted on a single vehicle, it teams an active electronically scanned array (AESA) radar incorporating an omnidirectional non-rotating antenna with a vertical launcher holding an estimated 30+ ready-to-fire missiles. Some sources claim that these are based on an air-to-air missile, while others suggest that they are a derivative of the 9M338 used by the TOR-M2. Maximum ranges of 5 and 10 km have been reported. MBDA's CEPTER is an example of a missile that was custom-designed to meet several roles. It first entered service in 2017 as the SEA CEPTER naval SAM, but development of the LAND CEPTER truck-mounted version is under way, and the first test launches were made last year. This variant will enter service with the British Army under the designation SKY SABRE.

Air-to-Air Missiles

The concept of using an air-to-air missile in the SAM role is not new. This is what the US Army did when it created the CHAPARRAL SAM system by adapting the AIM-9 SIDEWINDER for the new role. The SEASPARROW system's use of the AIM-7 SPARROW semi-active air-to-air missile is another example of this approach.

More recently, several missile-design teams have adapted air-to-air missiles for the SAM role. The Rafael SPYDER-SR system uses PYTHON 5 and DERBY air-to-air missiles (which use IR and active-radar seekers respectively), but in the longer-ranged SPYDER-MR variant, these missiles are fitted with a solid-propellant booster. Both systems use a truck-mounted traversable launcher. By adding a solid-propellant booster to its PL-12 air-to-air missile, China created the DK-10A SAM. Part of the NORINCO TL-50 system, this is mounted on a traversable launcher based on a 6x6 truck.



Aselsan's HISAR-A is another example of a missile that combines inertial and IR guidance. The same method is also being used in the heavier, and longer-ranged HISAR-O.

Inertial Midcourse Guidance

The growing use in air-to-air missiles of inertial midcourse guidance and terminal electro-optical homing has allowed weapons of this class to be used as vertically-launched SAMs. First fielded around 2012, MBDA's VL MICA system uses vertically-launched versions of the passive-IR-guided and active-radar guided MICA air-to-air missile. Romania is reported to be the only customer for the land-based version SAM system, but VL MICA has enjoyed significant sales success in its shipboard form.

Diehl BGT Defense has developed the IRIS-T-SL vertically-launched SAM system based on its successful IRIS-T missile. Designed to meet a German Air Force requirement for a lower-tier air defence system, the missile is equipped with a larger rocket motor and a drag-reducing nose cone, features that will provide a maximum range of 25-40 km. Other changes needed for the SAM role include a GPS/INS mid-course navigation system, and a radio frequency (RF) data up-link. The nosecone is ejected late in the flight in order to allow the missile's nose-mounted seeker to acquire the target and provide terminal guidance. The missile retains the same combination of aerodynamic and thrust-vector control as used in the original air-to air weapon.

The combination of inertial midcourse guidance is also applicable to custom-designed vertically-launched missiles. MBDA's CAAM is an obvious example, as are the Aselsan short-range HISAR-A (Alçak İrtifa Hava Savunma Füze Sistemi), and medium-range HISAR-O (Orta İrtifa Hava Savunma Füze Sistemi) currently under development in Turkey.

For the MIM-104A PATRIOT system, missile designers chose a combination of aerodynamic controls on the cruciform tail sur-

faces, but by the 1970s SAM designers had realised the limitations of traditional aerodynamic controls, so began to supplement these with a thrust-vectoring system. The 5V55 family of missiles that were its Russian equivalent of the first-generation PATRIOT missile used a combination of aerodynamic controls on the tail surfaces, and moving tabs located within the nozzle of the solid-propellant rocket motor. A similar configuration is used on the later 48N6 and its derivatives that supplanted the 5V55 series

odynamic/thrust control steering system dubbed "PIF-PAF". This scheme applies the thrust vectoring at the missile's centre of gravity, an arrangement that maximises its effectiveness.

While recognising the virtues of such a scheme, other design teams were content to adopt what they probably saw as more practical locations for thrust-vectoring sub-systems, and accepted any loss on overall effectiveness. For the improved MIM-104F (PAC-3) that entered production in 1999, an all-new missile was developed. Known as the PAC-3, this incorporates an array of 180 sideways-firing Attitude Control Motors mounted in the missile forebody. Used in the final stages of flight, these are intended to steer the missile to a direct hit on an incoming target.

Originally developed for the S-400 TRIUMF (SA-21 GROWLER), FAKEL's 9M96 series of missiles use a series of sideways-firing thrusters activated in the final moments of flight to reduce the missile's response time by an order of magnitude. The two basic versions are the 40 km range 9M96 and the 120 km range 9M94D. Both use inertial mid-course guidance, changing to an active-radar seeker in the end game. These missiles weigh 333 kg and 430 kg respectively, and are small enough to allow four to be packaged in a standard S-300/400



Lockheed Martin's PAC-3 missile was custom-designed for use against ballistic missile targets. It uses sideways-firing Attitude Control Motors mounted in the missile forebody.

in later versions of the S-300 (SA-10/20 SA-10 GRUMBLE/GARGOYLE).

The EUROSAM-developed missile that forms the main component of the ASTER-15 and ASTER 30 rounds for the shipboard Principal Anti-Air Missile System (PAAMS) and the ASTER 30 missiles for the land-based SAMP/T both use a hybrid aer-

launch canister in place of a single 1,500-1,800 kg class missile.

First seen at the MAKS 2013 exhibition, the Almaz-Antey S-350E VITYAZ medium-range air defence missile system is intended to replace the older members of the S-300P series. It combines the 50K6E combat control post, up to two unmanned



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The HQ-9 might be the first Chinese SAM to use track-via-missile guidance.

50N6E multifunctional radars, and up to eight 50P6E TEL, each armed with 12 canisters for vertically launched 9M96D-1 missiles. The use of a high degree of automation has reduced the number on system components, and the number of personnel needed to operate the system.

The 9M96 missile has also been used as the armament for South Korea's IRON HAWK II system. Developed as a replacement for that country's HAWK batteries, this combines a command control centre, an X-band 3D phased-array radar, and TELs armed with eight vertically-launched missiles.

EW Challenges

Long-range SAM systems such as the S-300 and -400 pose EW challenges to the attacker. Many deceptive EW techniques involve exploiting the sidelobes of the threat systems' radar antenna, using these to inject misleading information into the missile-guidance system. Many of these new generation SAM radars use passive or active electronically-scanned array antennas designed to have low sidelobes that can create problems for enemy deceptive EW systems, while the longer engagement range of missiles such as the S-300 and

-400 force standoff jamming aircraft to remain more distant, blunting effectiveness of their jamming.

Some medium/long-range SAM systems use a guidance technique known as 'track-via-missile'. These include the US MIM-104 PATRIOT, missiles for the S-300PS (SA-10b GRUMBLE) starting with the 5V55R, and the Chinese HQ-9 medium- to long-range missile.

In a conventional semi-active radar guidance system, the target is illuminated by a ground, ship, and fighter-mounted radar, and the radar energy reflected from the target is received by a missile-mounted seeker. In the track-by-missile technique, the seeker does not use its data to guide the missile to impact, but transmits it to the launcher via a datalink.

Guidance signals based on this missile-derived data and from the system's ground-based radar are then transmitted to the missile via an uplink. Since the generation of guidance commands is not being tackled aboard the missile by electronic subsystems designed as throw-away items, greater processing power can be applied to the task.

TVM requires the ground-based radar to be active throughout the engagement, making it a potential target for anti-radiation missiles. It also offers that attacker an additional method of blunting the system's effectiveness using EW. In addition to attempting to deceive the tracking radar and the receive channel of the missile's seeker, the attacker can also target the datalink that the missile uses to communicate with the ground-based tracking radar. Although the radar may be using an antenna with low sidelobes, making it hard for the attacker's EW system to inject a jamming signal, the antenna used to receive the missile's downlink is likely to have a wide beamwidth in order to reliably receive the signal from the missile as the latter manoeuvres towards a planned intercept. This wide beamwidth is likely to offer the attacker an opportunity to jam the system by disrupting the downlink.

Longer-range SAM systems offer a degree of anti-ballistic missile (ABM) capability. The PAC-3 missile currently used by the Patriot system flies most of its trajectory under the control of its onboard inertial guidance system. During the end game, it activates a nose-mounted Ka band active radar seeker.

MBDA's Block 1 NT programme is intended to improve the ABM capability of the ASTER 30 missile, giving it the ABM capability needed to engage medium-range ballistic missiles, and ballistic threats that carry separating warheads. This upgrade will include

Photo: US DoD



The days of fixed-site SAM systems seem numbered. This Iraqi S-75 (SA-2 GUIDELINE) launcher proved an easy target for allied air power during Operation Desert Storm in 1991.

Controp's Recent Image Processing Solution

At the Defence and Security Equipment International 2019 (DSEI 2019) exhibition in London, the Israeli company Controp Precision Technologies announced a new system intended to combine the capabilities from two of its current offerings – the TORNADO-ER land-surveillance system and the multispectral SPEED-ER.

Launched about six months ago, TORNADO-ER combines a 400 mm thermal imaging (TI) camera with another of 100 mm focal length. Both are based on 3-5 micron sensors and have fields of view of 1.38 and 5.58 degrees respectively.

The entire system weighs 75 kg, and incorporates two-axis gyro-stabilised gimbals that are able to counter the effects of vibration if the device is mounted on a ship's mast. TORNADO-ER can create a panoramic view at elevations ranging from +20 to -20 degrees, scanning a full 360 degrees in azimuth every three seconds, and automatically detecting moving targets as small as minor surface craft or swimmers.

SPEED-ER was announced about a year ago. It uses the same pattern of gyro-stabilised gimbal, in this case offering elevation ranges of +20 to -35 degrees, or +70 to -10. It teams a TI camera based on a cooled 3-5 micron 640 x 512-pixel detector, a high performance SWIR (0.9-1.7 micron) camera with a 640 x 512 pixel detector, a 1,920 x 1,080 pixel wide field-of-view (FOV) colour day camera,



Controp's SPEED-ER (left) and TORNADO-ER (right) were shown side-by-side at the Security Equipment International 2019 (DSEI 2019) exhibition in London.

Photo: Doug Richardson

and a 1,920 x 1,440 pixel narrow FOV colour day camera. A 1.54-micron eye-safe laser rangefinder can also be installed as an optional extra.

Most of the SPEED-ER cameras are fitted with a continuous zoom lens. The x5 optical zoom lens of the SWIR camera has a maximum focal length of 2,500 mm, giving FOVs down to 0.22 degrees, while the x30 optical zoom lens of the TI camera has a maximum focal length of 1,400 mm, giving FOVs down to 0.39 degrees. The narrow FOV TV camera has a dual lens offering angular coverages of 0.8 and 0.2 degrees.

Both products offer image processing capabilities which include local automatic gain control (AGC), video enhancement, automatic scanning, and an automatic video tracker.

Given the complimentary nature of the two systems, Controp has decided to offer them in teamed form for tasks such as coastal surveillance role. TORNADO-ER would provide wide-angle surveillance, passing targets of interest to the SPEED-ER, so that the latter would provide the detailed imagery needed for identification and threat assessment. The combination can cope with the visibility effects of high levels of humidity, and offers a detection range of more 50 km, Controp's Senior Director Marketing Nir Bar Natan told European Security and Defence on the day that the system was announced.

fitting the missile with a new seeker operating the Ka-band rather than the Ku-band band of the current version.

The S-300PM (SA-20 GARGOYLE) is reported to be able to counter missiles with re-entry speeds of up to 2.8 km/sec. It teams a new 30N6 (TOMB STONE) fire-control radar with a the new longer-range 48N6 missile.

'Shoot and Scoot'

In any air campaign, enemy SAM systems are a high-priority target for the attacker. 'Shoot and Scoot' – a long-established tactic for artillery units – may prove as essential tactic, and the more mobile a SAM system is, the more likely it is to survive.

Classic examples of early mobile SAMs were short-range systems such as the BAC Rapiere (which used towed hardware) and the vehicle-mounted Thomson-CSF CROTALE, Euromissile ROLAND, Soviet-era 9K33 OSA (SA-8 GECKO), and 9K31 STRELA-1 (SA-9 GASKIN). Early long-range systems such as the US NIKE AJAX, the Russian S-75, and the British BLOODHOUND were semi-mobile at best. With the S-75, the task of set up or

redeploying a battery took several hours, and the medium-range S-125 would not be much of an improvement. The US medium-range HAWK system consisted of a large number of component elements, including no less than four different radar systems, plus the launchers and command vehicles. These were typically mounted on wheeled trailers, so the overall system was semi-mobile at best.

Russian designers took a different approach when planning the 2K12 KUB medium-range system. Although the 3M9 missile was similar in weight to a US HAWK missile, the launcher, and its associated 1S11 target-acquisition and distribution radar and a 1S31 continuous-wave illuminator radars were mounted on tracked vehicles.

Mobility was seen as an important requirement when the S-300 system was first planned, and the original plan was the mount all major system elements on a MAZ-543 all-terrain chassis. Delays with the latter forced the creation of an interim system designated S-300PT (the letter 'T' indicated transportabelnii - the Russian word for 'deployable'). Since the S-300PT used containerised system components and trailer-mounted launchers, it did not meet the mo-

bility requirements originally envisaged, but the follow-on S-300PS (Samokhodnyi = self-propelled) known to the West as the SA-10b GRUMBLE mounted the system on modified MAZ-543 vehicles. This concept of making medium-range systems mobile was also applied to the follow-on S-400 TRIUMF, and to the long-range S-500 – which seems to be Russia's equivalent to the US Terminal High Altitude Area Defence (THAAD) system.

SEAD Missions

A combination of mobility, camouflage, and decoys will complicate future Suppression of Enemy Air Defences (SEAD) missions, but future SAM operations will definitely be a case of 'survival of the fittest'. The manufacturer of one now-retired mobile SAM system once predicted to the writer that the weapon system in question was unlikely to survive on the battlefield for long enough to need a reload, while the destruction of a PANTSIR-S1 (SA-22 GREYHOUND) belonging to the Syrian Air Defence Force by the Israel Defence Forces in May 2018 showed that even modern systems can be vulnerable to attack. ■

Legge Navale: Italy's Fleet Renewal Programme



Photo: Italian MoD

Interview with Vice Admiral Chief Inspector Matteo Bisceglia (retired)

Before leaving his position in September 2019 to become Director of OCCAR EA, Vice Admiral Chief Inspector Matteo Bisceglia was Head of Naval Armaments Directorate (NAVARM) of the Italian MoD. ESD had the opportunity to talk to him about the Italian fleet renewal programme “Legge Navale”.

ESD: Under your leadership, the Italian MoD's Naval Armaments Directorate launched the development, shipbuilding and delivery phases of the Italian Navy's Fleet renewal project under the so-called 'Legge Navale' programme which saw the contract awards in 2015 for the seven (plus three options) new design THAON DI REVEL class multipurpose combatant offshore patrol vessels (PPA, Pattugliatore Polivalente d'Altura), the TRIESTE class LHD (Landing Helicopter Dock), the VULCANO class LSS (Logistic Support Ship) and later for the two CABRINI class UNPAV (Unità Navale Polifunzionale ad Alta Velocità) vessels for special forces support. Can you give us an insight into this historical programme?

VADM Bisceglia: In early 2014 when I was working as head of FREMM PD at OCCAR, the former Italian Navy's Chief of Staff Vice Admiral Giuseppe De Giorgi instructed me to lead this project. I then began to work on the project prior to assuming the command of NAVARM in May 2014, and I established two working teams – one team for dealing with the PPA and the other for the remaining ships programmes. Without the continuous and tireless commitment of men and women of NAVARM and the Navy's Chief of Staff, we wouldn't have been able to celebrate an overall contractual agreement with Fincantieri (as prime contractor) and Leonardo, in late 2014. Due to the Parliament's programme funding approval process, however, we were able to award the contracts only in 2015.

ESD: As with the joint French-Italian FREMM multi-role frigate programme, PPA and LSS are managed by OCCAR. What are the advantages that have led Italy to join this programme?

VADM Bisceglia: Based on the experience and the lessons learned with the FREMM programme, we decided to put the PPA and LSS under OCCAR's management as the Agency offers greater contractual flexibility compared to national programme management and it also opens these projects to the participation of third parties, as demonstrated by the French joining the LSS

programme. Italy wants to continue along this path with the new U212 NFS (Near Future Submarine) and later with the new Multi-Role Mine Countermeasures Vessels (MCM) programmes, as well as with France for the mid-life upgrade of HORIZON destroyers, the future European Patrol Corvettes (EPC) and the new research and development programmes to be launched by the joint-venture of Fincantieri and Naval Group on surface vessels. The EPC represent one of the first projects of the agreement between Fincantieri and Naval Group (POSEIDON project) and therefore one of

Photos: Italian MoD



In 2015, the Italian Navy ordered seven new THAON DI REVEL class multipurpose offshore patrol vessels.

the future common programmes. Exploiting the PESCO (Permanent Structured Cooperation) framework, Italy has proposed France to develop the new patrol vessels (with ASW capabilities among others), within the new European initiatives. The new multi-role MCM vessel programme is also eligible to be managed by OCCAR as Germany has a similar requirement.



The Italian FREMM multi-role frigate programme is managed by OCCAR.

ESD: NAVARM plays a key role in supporting Italy's national interests and naval and defence industrial texture abroad. Can you point out the Directorate's latest efforts in this sector?

VADM Bisceglia: The so-called 'Country System' putting together institutions and industry has gained important successes in recent years. NAVARM is part of this system and has been instrumental in programmes such as the Qatar Emiri Naval Forces (QENF) fleet renewal plan assigned to Fincantieri with Italian Navy support, as well as supporting the Italian and French Governments together with French DGA in creating the assumptions for the Fincantieri/Naval Group joint-venture on surface vessels establishment to mention the most important.

ESD: The First-of-Class (FoC) PPA PAOLO THAON DI REVEL was launched last June by Fincantieri and is ready for harbour and sea trials. Can you highlight the innovations introduced by this class of ships and which is the shipbuilding programme schedule?

VADM Bisceglia: The PPA is a class of new multipurpose combatant offshore patrol vessels whose characteristics meet the Italian concept of "Multi-Purpose by Design" shared within the NATO community. This concept will allow the Italian Navy to cope with dynamic and complex operational challenges and maintain maritime control with appropriate and timely actions, making it possible to carry out different profiles of operations. The PPA, which since its inception has been designed either for traditional mili-

tary tasks or to support humanitarian and disaster relief operations, is characterised by a high degree of innovation, which provides the vessels with a considerable degree of efficiency, flexibility and environmental sustainability whilst serving different mission profiles. Based on a common platform, the PPAs are built in 3 different configurations: the 'Light' version (2 ships) has a full set of

artillery while the 'Light Plus' (3 ships) adds a missile firing capability with actuators also planned for ballistic missile defence. Both are 'fitted for' to be equipped as the 'Full' version (2 ships), which will be able to operate in all traditional warfare domains. Under the supervision of NAVARM and the OCCAR PPA Programme Division, the FOC PPA PAOLO THAON DI REVEL (in the Light version) will soon be at sea by mid-October, only four years after contract signature, with a delivery planned for May 2021. To be completed by end-2026, the seven PPAs shipbuilding programme also includes a 10-year support package and options for 3 additional ships.

ESD: The new frontline and support ships designed and built under the Legge Navale are equipped with state of-the-art modular and scalable combat system including new generation command management system, sensors, communications and weapon systems. Can you highlight the main systems' capabilities?

VADM Bisceglia: The Italian MoD, Navy and industrial efforts behind the Legge Navale shipbuilding programme have been unprecedented. Together with the new platforms characterised by dual-use capabilities which reduce the environmental footprint and maintenance and logistic needs, the new ships are equipped with a new-generation common and modular combat system developed by Leonardo based on Italian MoD and Navy requirements and support. The PPA's fourth generation "SADOC 4 command management system" manages a

sensors suite based on a new dual band ('C' and 'X') radar (DBR) and Elettronica EW suite integrated together through a 'system manager', a new Distributed Static Staring (DSS)-IRST suite and NA-30S Mk2 fire control. The MBDA SAAM ESD PPA surface-to-air missile system will be able to deal with ballistic missile threats while the Leonardo 127/64 mm main gun mount will use VULCANO long-range guided munitions. The new low weight/footprint 76/62 mm SUPER RAPIDO 'Single Deck' version will be able to provide a complete range of missions for both national and foreign navies. Considering that the FoC-PPA will be delivered six years after its contract award, the technological challenge behind this programme becomes understandable, where the development of new systems represents 70-80%, while the new developments at FREMM represent only 30-40%.

ESD: The OCCAR-managed Logistic Support Ship (LSS) programme has reached an international dimension after the French MoD selected to join and awarded a contract for four ships. Can you tell us what stage the Vulcano LSS programme of the Italian Navy is at?

VADM Bisceglia: Before the VULCANO LSS was struck by a major fire during vessel fitting-out, the programme was on schedule and within costs. However, the event caused delays and today after a complete superstructures rebuilding, outfitting and overall re-certification, the ship is scheduled to begin sea trials by the end of the year and will be delivered by September 2020. The benefits offered by OCCAR's programme management and the ship design capabilities have been instrumental for the French MoD to select a customised-LSS project for their own requirements and join Italy, while Brazil is programme observer. Conceived since the beginning of the design phase with enhanced "dual use" features, the LSS will be capable to support multiple missions, spanning from naval Joint Task Force to HQ afloat operations, to provide medical support (NATO Role 1/Role 2 LM) and naval and aviation fuel, fresh water, ammunition, lubricating oil, food, spare parts and 20 ft ISO containers, in addition to support Humanitarian and Disaster Relief Assistance Operations.

ESD: The new TRIESTE LHD (Landing Helicopter Dock) was launched on schedule last May at Fincantieri's Castellammare di Stabia (near Naples) shipyard. Can you elaborate on the enormous leap in amphibian, command and flight capacity compared to current dedicated platforms?

VADM Bisceglia: The new TRIESTE LHD has been conceived as a dual-use platform for a wide range of military and humanitarian/disaster relief operations and, as you said, represents a huge leap in terms of amphibious, command & control and air capabilities compared to in-service platforms. With a 37,000 tonnes-plus full load displacement, 245 m length and 47 m beam, it is the biggest platform to enter in service with the Italian Navy and it has a flight deck with ski-jump, hangar, maintenance and mission planning facilities for both F-35B short take-off and vertical landing (STOVL) and rotary-wing operations. The LHD is equipped with a stern well deck for latest generation LCM (Landing Craft Mechanised) as well as a same-level garage capable to accommodate main battle tanks. With accommodation for up to 1,064 personnel, including a 360-members crew, the ship has extensive NATO Role 2E hospital and amphibious/complex command and communication systems and facilities in addition to a command, control and communication management suite provided by Leonardo with new generation long-range fully-digital L-band AESA Kronos Power Shield and X-band multifunction radars, DSS-IRST, Elettronica EW and an inner-layer defence suite based on 76/62 mm SUPER RAPIDO guns with guided munitions and remotely controlled 25 mm guns. The TRIESTE LHD is planned to be delivered to the Italian Navy in June 2022.

ESD: The Legge Navale also includes the programme for two Unità Navale Polifunzionale ad Alta Velocità (UNPAV) platforms supporting the Italian Navy's Special Forces and Diving Command (COMSUBIN). Can you elaborate on the programme achievements?

VADM Bisceglia: The first of the two new high-speed composite-made multi-purpose patrol vessels dedicated to transport and operate with the Italian Navy's elite naval command force (COMSUBIN) special teams has been delivered by Intermarine beginning of July, while the second was launched last May and is to be delivered in February 2020. With a full load displacement of 185 tonnes and a length of 44.16 metres, the UNPAV are equipped with a propulsion package with waterjets offering a 30-plus knots max speed and capable of transporting two 9-operator special teams in addition to the crew. Featuring a ballistically protected navigation and C2 bridge station, the UNPAVs have a stern launch and recovery station for a Special Forces 7.3 metres RHIB and are armed with a remotely operated 12.7mm gun in addition to 7.62 mm Gatling Miniguns.

ESD: With the OCCAR-managed French-Italian FREMM programme sailing towards the completion of frigates delivery, the focus is on in-service support.

VADM Bisceglia: With the 9th (ITS Schergat) FREMM General Purpose (GP) frigate expected to be delivered in March 2020 and the 10th (ITS Bianchi) to be launched

master a contract to design, develop, build and delivery the first-of-class new-generation boat in addition to an initial logistic and in-service package. The same contract will include options for the remaining three boats procurement and inserting new technologies on in-service boats' midlife upgrade and cooperation activities. As the



The Italian Navy's new TRIESTE LHD was launched at the Fincantieri shipyard in Castellammare di Stabia in May 2019. It is the largest Italian military ship built after the Second World War.

in January 2020, OCCAR has signed with Orizzonte Sistemi Navali (the joint-venture between Fincantieri and Leonardo) as prime contractor on June 2019, a Through Life Sustainment Management (TLSM) contract to provide in-service support over the next 5 years for the 10 Italian FREMM frigates. The contract also provides the option for the inclusion of the French side in the support of common equipment installed on board the eight French FREMM frigates. A true testament of the synergies between the ITN, OCCAR FREMM PD and industry, the contract represents also a significant step forward in the French-Italian cooperation within the framework of Common In-Service Support.

ESD: Italy's Defence Multi-year Programmatic Document (DPP, Documento Programmatico Pluriennale) for the 2019-2021 period reinstates the need for procuring four new AIP-equipped submarines under the Near Future Submarine (NFS) U212 programme. Can you tell us about the state of the programme and the main features of the new platform and its combat system?

VADM Bisceglia: The NFS U212 programme is being developed on the successful U212 A submarine, developed jointly by Italy and Germany, to replace four in-service updated SAURO class boats, whose funding has been confirmed under the latest Italian MoD's DPP 2019-2021. The multi-year €2.35Bn programme required NAVARM to

contract is expected to become effective by 2020, a first-of-class NFS 212 entry-into-service is foreseen for 2025. As an evolution of current U212A boats, they will feature significant Italian industry content with a range of enhancements including a slightly longer hull with a new very-low profile sail concept and electrically-actuated masts, a propeller optimised cap combined with pre-swirled rudders, nonmagnetic special steel, a fluoropolymer foul release hull coating to reduce fuel consumption, and a new ballast tanks emergency blowing system. The Italian MoD invested in a nationally-developed propulsion and energy storage system centred initially on new-generation Lithium-ion battery system and subsequently sided by a second-generation fuel-cells Air Independent Propulsion (AIP). The new platform is to feature a new-generation combat and communication suite and centre, new underwater and surface sensors, UUVs, Leonardo's BLACK SHARK Advanced (BSA) torpedoes and potentially strike missile capability. The whole programme is planned to cover the four submarines plus a ten-years logistic support package and an upgraded training centre.

ESD: The DPP 2019-2021 also reinstates the procurement programme for a new Special Forces and Diving Operations/Submarine Rescue Ship (SDO/SURS) vessel

to replace the aging ANTEO platform in service since 1980. Can you elaborate on the multi-mission capabilities of the new platform?

VADM Bisceglia: The SDO/SURS will have a modular design to accomplish three main tasks in support of the Italian Navy's diving and Special Forces Command (COM-SUBIN): to act as a support ship for diving operations in 'dual-use' applications, to ensure special forces projection in the theatre of operations and to provide a deployable command platform for both operation/training related to amphibious and underwater missions. The SDO/SURS will be equipped with advanced diving equipment to rescue personnel of submarines in distress with either a deployable resident or another NATO navy's Submarine Rescue System (SRS) and a Submarine Rescue Diving Recompression System (SRDS), as well as related medical and extended SF C2 facilities. The SDO/SURS will be able to deploy a suite of survey and rescue underwater vehicles, including a 3,000-metres deep-capable AUV and remote-controlled vehicles. The Italian Navy has evaluated both manned and unmanned submarine personnel rescue systems. The €424M programme planned to become effective in 2020 includes the platform shipbuilding, outfitting and delivery, the underwater operations equipment suite, an integrated support package for 10 years as well as an advanced hyperbaric dual-use centre for military and civil personnel training and applied medicine research.

ESD: The third naval programme to be funded from 2019 regards the development, production and support of the new 'EVO (Evolved)' version of the MBDA TESEO Mk2 anti-ship missile. Can you give us an overview of the new version and its expanded operational capabilities?

VADM Bisceglia: The development, test and procurement programme for the new TESEO Mk2/E version has been finalised to safeguard the surface-to-surface capability of the Italian Navy, with an initial development phase to be followed by qualification, industrialisation and production, sided by the obsolescence cure of the current MBDA TESEO Mk2/A. To satisfy latest operational requirements, we have been working on a tailored heavy anti-ship solution sharing technology communalities with the new MBDA MARTE ER medium-range anti-ship missile and based upon an evolved TESEO missile with developments in the transonic airframe, propulsion with turbofan-based package, flight controls, guidance package with SATCOM update, warhead, launcher and mission planning, towards greater terminal ef-



The new Italian Logistic Support Ship (LSS) will be able to support a wide range of naval missions as well as humanitarian and disaster relief operations.

fectiveness at range and land attack capability. The enhanced guidance package will be based on an advanced radar seeker with active electronically scanned antenna (AESA). The definition of the technical specifications is ongoing. We are working on a contract to become effective with MBDA in 2020 with the aim to maintain a surface attack capability in the future and potentially capable to offer technologies in joint international missile projects such as the Future Cruise and Anti-Ship Weapon (FCASW) programme.

ESD: The DDP 2019-2021 also highlights for the first time the requirement to fund from 2019 a new Major Hydro-Oceanographic Vessel (Unità Idro-Oceanografica Maggiore, NIOM) programme to replace the MAGNAGHI platform which has reached its end of life after 44 years of service.

VADM Bisceglia: The new Major Hydro-Oceanographic Vessel has been conceived and designed as a 'dual-use' platform to ensure both military-related as well as scientific research missions. The NIOM will serve both Defence and other Ministerial agencies, being capable to contribute to scientific research in arctic areas. With a highly reduced environmental impact to operate in protected areas, the NIOM will have accommodation for 36 technicians and scientists, facilities and systems to conduct hydro-oceanographic mission in isolated areas. The new platform will be capable to conduct surveys from very shallow to very deep (up to 10,000 meters) sea beds, conduct bathymetric surveys for port access routes as well as search and investigation of shipwrecks up to 10,000 metres, collect hydro-oceanographic data up to 5,000-7,000 metres and conduct operations in light ice conditions, with an icebreaker support when neces-

sary. The €300M procurement programme includes an integrated support package for 10 years.

ESD: The DPP 2019-2021 addresses for the first time the requirement for a class of 12 new Mine-Counter-Measures Multirole Vessels (Unità Navali Polivalenti di Contro-Misure Mine) to be funded incrementally from 2020-2021 period. Can you elaborate on programme requirements, platform and onboard systems?

VADM Bisceglia: We are only at the feasibility study phase to be launched from 2020 of a procurement programme for a new class of larger and multirole 'non stand-off' MCMV. Based on the experience and lessons learned by the Italian Navy, NAVARM and industry headed by Intermarine for the platform and Leonardo for the dedicated C2, we are looking to a 76-78 metres long 'non stand-off' platform with low acoustic and magnetic signature with high resistance to shock thanks to a composite-made hull, capable of cruise speeds compatible with the rest of the fleet and high persistence in the theatre of operations, in addition to a self-protection suite and large and modular spaces and facilities for vehicles and MCM systems. The latter depends on the toolbox of autonomous/remotely operated vehicles to be operated simultaneously by a new generation C2 for both 'stand-off' and 'non stand-off' MCM operations. The platform will be able to manage both unmanned surface and aerial vehicles, both operating as mother platforms for sensors and systems in addition to remotely operated MCM vehicles, including the mine influence sweeping operations.

This interview was conducted by Luca Peruzzi.

Unmanned Ground Vehicles for Combat Support

Giulia Tilenni

Despite less developed versions than in the air, unmanned land vehicles are also gaining in importance. The operational uses have steadily expanded in recent years, increasing the range of available solutions. Nevertheless, there is much room for further development, especially in terms of combat support duties.

Unmanned ground vehicles (UGVs) have been demonstrating increasing strengths in coping with today's operations: deployability in 4D (dangerous, dull, difficult and dirty) missions, minimisation of risks for troops due to remote control, allowing them to be operated from secure areas, and force protection capabilities, as they can be used to 'clean' the theatre before the troops arrive.

In addition to these features, which they share with Unmanned Aerial Vehicles (UAVs), UGVs have some special characteristics regarding the operational environment for which they are used. Depending on the payload, they can perform tactical missions such as ISR/ISTAR and patrols, detection and neutralisation of CBRN threats, mines and explosives, and heavy trucks, including Medevac (medical evacuation). In their smallest versions, UGVs provide detailed situational awareness in urban or mountainous environments or collect information and capture images of areas inaccessible to other ISR assets. The array of missions UGVs can be used for is expanding and an increasing number of states expressed interest in these technologies. In particular, two trends emerge. First, the development of modular UGVs, usually limited in size and rapidly adaptable to mission profiles – due to a broad spectrum of payloads. Over time, payloads have been developed to include remote-controlled weapon stations as well. Second, some countries are researching on UGVs for combat missions, including the gradual integration of unmanned features on manned systems (encompassing the development of unmanned turrets), the transformation of existing manned vehicles in unmanned, and, for a few countries, the development of true combat UGVs.

So far, technical issues such as poor survivability and the need for stability have constrained

the growth potential of UGV solutions. As a result, UGVs have rarely supported troops during combat missions in contested areas or in the last mile, being rather used in urban environments or for support services on the second line. Moreover, technical issues have negatively affected the development of combat UGVs, which has progressed more slowly than for modular UGVs.

Weaponised UGVs

So far, armed UGVs have been mainly limited to modular, weaponised models. Modularity has allowed users to choose payloads according to mission profiles – for instance,

market. TheMIS, a 1450 kg system with a 750 kg maximum payload, is intended to provide support for dismounted troops. It reaches a top speed of 20 km per hour, with an outstanding endurance of 15 hours of constant operations without refuelling in the hybrid configuration. TheMIS can serve as combat support platform, disposal unit, and remote weapon station, and can be rapidly reconfigured. Robustness, reliability, stability, a low to zero noise signature and an open architecture are among its core features. This UGV is proposed in three different versions: combat support, UAV carrier and weaponised version integrating a remote weapon station.

Photo: Milrem



Milrem's TheMIS deFNder Medium integrated with FN Herstal's remote weapon station.

counter-IED/counter CBRN and Medevac. In case of fire support or other combat missions (for example, armed ISTAR), it is possible to integrate small or medium calibre remote weapon systems on a basic platform. TheMIS, launched by the Estonian company Milrem Robotics in 2015, shows well to what extent modularity can be exploited for developing successful solutions for combat support.

The Tracked Hybrid Modular Infantry System (TheMIS) is one of the first hybrid diesel/electric full modular UGVs launched on the

In the combat support version, TheMIS can be deployed for transport (Medevac and logistics), detection (reconnaissance, observation, patrol, fire control and CBRN detection) and firefighting. It can be equipped with sensors to enhance situational awareness, and it can be outfitted with restraints and tie downs to prevent load shift. The system is optimised for deployment in harsh environments (sand, snow and mud), and can pass through 60 cm of water. Moreover, the charge can be lifted on top to ease operations in wooded areas.

Author

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When configured as UGV carrier, TheMIS features the Threod System KX-4 LE (Long endurance.) TITAN, a heavy-lift multirotor that can be equipped with different plug and play payloads. The drone can be battery-powered (45 minutes long endURANce and 6 kg strong lift capability), or tethered,



Milrem's TheMIS deFNder Medium integrated with FN Herstal's remote weapon station.

Attack Combat Turret) system, consisting of two MMP anti-tank guided missiles and sight unit. After an eight month-long study, the Estonian and the French companies have thus been able to launch the world's first anti-tank UGV. On the same occasion, Milrem revealed a new system developed in co-operation with the Australian tech company Electro Optic Systems, fitted with the R400S-Mk2-HD (dual) remote weapon system, mounting a 30mm ATK M230 LF cannon and a coaxial 7.62mm general-purpose machine gun.

In recent years, Milrem's products have been tested by armed forces in Europe, the US and the Middle-East during military exercises, which is telling about the interest in these technologies and will allow for improvements in the features of this UGV. In the transport and deFNder configurations, TheMIS participated in the Spring Shadow exercise with Estonian forces in 2017 and 2019. Milrem and ST Engineering demonstrated TheMIS's ability to operate beyond-visual-line-of-sight (BVLOS) during a live-fire exercise of the Estonian Defence Forces last April. In May 2019, Milrem delivered two UGV to the Dutch Armed Forces as part of their Concept Development and Experimentation Project. The UAV carrier model has recently participated in a five-month assessment with the Estonian armed forces in Mali to integrate lessons learned in the Research and Development process.

The number of countries willing to include weaponised UGVs in their inventories is increasing, and the array of available solutions is expanding accordingly. Rheinmetall's MISSION MASTER – PROTECTION is one of the latest UGVs to have been tested – namely at the Ammunition Capability Demonstration 2019 held in South Africa in March with the participation of 53 country delegations. The system featured the

company's FIELDRANGER multi-weapon station equipped with Thales 70mm rocket launchers. According to Rheinmetall, the live demonstration marked one of the first use of an air-to-ground system in an air-to-ground role.

Other possible configurations of this modular system include 50mm weapon systems, 12,7mm machine guns and 40mm grenade launchers.

UGVs for Combat Missions

An increasing number of states is seeking to develop UGVs deployable on the battlefield with the aim of providing additional combat support to soldiers and replace them for the most demanding tasks whenever possible. So far, however, the potential of UGVs has been somehow underexploited due to technical issues that have curbed enthusiasm and slowed down mass production. The poor survivability and the struggle to find the best payload configuration are the main issues defence companies have been confronted with.

Just like with tactical UAVs, the lack of protection from kinetic and non-kinetic threats is a serious concern with the deployment of UGVs on the battlefield, especially for what concerns the development of larger models. However, as UGVs are used in the land environment, non-kinetic countermeasures (for example, electronic warfare) could prevent mission accomplishment, yet without necessarily ending in the loss of the system – as would be the case with UAVs. Conversely, vulnerability to kinetic measures remains an issue to address, especially for what concerns smaller models.



In partnership with Milrem, Leica Geosystems developed the PEGASUS: MULTISCOPE UGV for off-road use in surveying, security, and monitoring applications. The UGV mounts Leica's PEGASUS mobile mapping system with Milrem's MULTISCOPE UGV.

thus being able to reach a 80 metres long range and a 4 kg lift capability. For military applications, the drone can be used for battlefield reconnaissance and surveillance, as well as for fire support and battlefield damage assessments.

Weaponised configurations, named after the weapon station integrated on the system, are probably the most interesting ones tested so far. Three configurations are already available – ADDER, deFNder and PROTECTOR. ADDER was the first configuration to have been tested. It integrates the ST Kinetics remote weapon station, and can mount one or two coaxial weapons, such as 7.62mm machine guns, CSI 40AGL 40mm automatic grenade launchers, and CIS 50MG 12.7 mm heavy machine guns. TheMIS deFNder Medium integrates Milrem's platform with different FN Herstal remote weapon stations: FN MAG (7.62mm), FN M2HB-QCB (12.7mm), FN M3R (12.7mm) and 40mm AGL. PROTECTOR, launched in 2017, can mount one of the Kongsberg's remote weapon stations, including a machine gun and a JAVELIN missile system.

Additional configurations have been tested in the last years. At Eurosatory 2018, Nexter presented OPXIO X-20, combining TheMIS remote control platform with the Nexter ARX-20 remote-controlled 20mm turret. At IDEX 2019, the Estonian company unveiled a new variant of its TheMIS platform, featuring one FN 7.62mm machine gun and a MBDA IMPACT (Integrated MMP Precision

Finding the best payload configuration to make UGVs stable enough to safely achieve mission objectives is crucial. This issue is particularly important when it comes to mountainous terrains, where UGVs might significantly support dismounted troops – especially for carriage duties. Well aware of this requirement, defence companies have been working to find dedicated technical solutions. For instance, Milrem decided to lower the TheMIS' centre of gravity to give it a greater level of stabilisation in harsh environments.

Unmanned MBTs

Once UGVs crucial issues are solved, especially concerning stabilisation, the potential uses of these systems will be expanded to proper combat missions – namely combat reconnaissance and fire support on the battlefield.

to the lessons learned from the deployment of these systems, JSC 766 UPTK unveiled the first Russian combat UGV in 2015 – with the support of Rostec Corporation for exports. URAN-9 consists of four unmanned ground vehicles, a mobile command station (mounted on a 6X6 tactical truck) and a tractor for transport. URAN-9 is powered with diesel-electric technologies, thus being able to reach a 35km/h speed on highways, which slows down to 10 km/h in off-road conditions. The UGV can be operated in manual mode or perform pre-programmed missions autonomously, alone or in column with other UGVs. It can be fitted with different weapons according to the mission profile. The panoply includes 9M120-1 ATAKA anti-tank guided missiles (up to four), Igla surface-to-air missiles (up to four), 9K333 VERBA man-portable air defence systems, and 9M133M KORNET-M anti-tank guided

The possibility to develop unmanned combat vehicles is part of the US Next-Generation Combat Vehicle programme, expected to be completed by 2035. The US Army will test, in the fourth quarter of 2019, legacy M113s converted into armed robotic platforms, to better define the requirements for the Robotic Combat Vehicle programme. The programme, which aims at developing an unmanned system fast and light as a STRYKER but with firepower features similar to M-1 ABRAMS tanks, will likely include light, medium and heavy systems. M113 have been refitted with 'drive-by-wire' features that enable teleoperated or autonomous capacities. The US Army likely seek unmanned systems that can be controlled from a manned platform.

Ankara has already expressed its interest in developing a domestic-produced unmanned MBT. However, Turkish defence industries do not possess the skills and know-how needed to respond to this in the medium term. Conversely, Aselsan and Katmercieler launched in 2017 the 'U'remote controlled shooting platform', fitted with Aselsan's SARP remotely controlled weapon stations. According to official Turkish sources cited by Anadolu Agency, some 20 vehicles have been used for counter-terrorism operations on the Syrian border in 2019.



Photo: ESUT / Heiming

In convoy an armed MISSION MASTER – PROTECTION and a MISSION MASTER – RESCUE for the transport of wounded persons

The interest for developing combat UGVs goes well beyond the usual strengths of unmanned vehicles, as it could end in 'transforming' these vehicles in unmanned main battle tanks (MBTs). Such a process could somehow 'ease' the development and production of the most complex system used in the land environment. One of the main technical challenges of building a MBT is to provide the crew with enough air and space, and with sufficient protection, namely by armouring the system accordingly. Developing an unmanned MBTs promises to solve – in principle – these technical challenges due to the lack of on-board personnel.

Research is ongoing in the Russian Federation, China, and US, with Turkey expected to follow in the future, to develop fully unmanned MBTs with a certain degree of autonomy.

At first sight, Russia can be considered at the forefront of research in combat UGVs. Since the mid-2010s, the country has been operating some UGVs for support activities such as fire-fighting and minefield clearing. Probably due to the know-how gained and

missiles (up to six). However, URAN-9 poorly performed during its first deployment on the battlefield, in Syria in May 2018. A lower operational range than expected and firing issues were identified as the main weaknesses. Senior Russian experts concluded that URAN-9 is still unable to perform assigned tasks during classic combat operations, arguing that a decade will be likely needed to fill this gap. Nevertheless, Russian authorities confirmed last June that some foreign countries expressed interest in purchasing the system.

2018 marked also the debut of China among countries possessing some combat UGVs capabilities. According to Chinese TV footage released in March that year, China has tested an unmanned version of its Type 59 MBT. According to Chinese sources, the country has transformed some of its Russian-made MBTs in unmanned versions due to artificial intelligence. Although no other information has been released since then, the test demonstrates that unmanned features are included in the extensive Army modernisation programme Beijing is working on.

Manned-Unmanned Teaming in Combat Operations

The development of UGVs for combat operations could finally end in some sort of manned-unmanned teaming in which the role of UGVs goes beyond the simple support during operations. In practice, UGVs could be in charge for tasks, which are demanding but do not necessarily require human intervention to be accomplished, with soldiers remaining responsible for the remaining tasks.

Such an organisation could not only further reduce the risk for troops, but also maximise UGVs features, especially in terms of rapidity. Indeed, unmanned systems could react faster than the human brain when integrated with artificial intelligence features. Concerning combat missions, unmanned MBTs could replace infantry to facilitate manned MBT manoeuvres on the battlefield.

The US have already included manned-unmanned teaming among the prerequisites for the Next-Generation Combat Vehicle programme cited above.

Final Remarks

As for UAVs, UGVs could become game changers in the future. The impact that these technologies could have on the land envi-



Photo: Alf van Beem

China converts obsolete junk into AI-controlled drone tanks: Recent footage released by Chinese TV broadcaster China Central Television (CCTV) revealed a new indigenously-built unmanned Type 59 tank, undergoing testing at an unidentified location in China.

ronment will depend on the possibility to enhance their autonomy due to the integration of technological innovation and from the broadening of combat missions they can be deployed for (for example, heavy weight carriage to the last mile and small damages' reparations, also under enemy fire). Going back to THeMIS, features such as waypoint navigation, swarming and 'follow me' options are reported to be under development. In the future, the integration with some forms of artificial intelligence could enhance the autonomy of UGVs and even end in the

development of fully autonomous systems that could replace soldiers for demanding tasks or, depending from the degree of development, for full missions. Indeed, a well developed autonomous system could even perform better than soldiers, for instance for what concerns the rapid response to enemy fire. Nevertheless, operating fully autonomous systems could have disadvantages as well, for instance the inability to suddenly reshape an ongoing operation to follow sudden environmental changes or to fix eventual errors in target identification.

Concerning combat UGVs, and in particular the possibility to develop unmanned MBTs, unmanned technologies could revolutionise combat vehicles' philosophy, so far affected by the need to protect on-board personnel. In particular, the absence of crew might have a positive effect on armoured protections and, consequently, on weight, leaving room for making combat vehicles more efficient. On the other hand, unmanned combat vehicle need a higher number of on-board sensors compared to manned versions, thus making effective cyber protections and anti-jamming technologies of crucial importance. Although the combat UGV market is particularly interesting from a technical viewpoint, this will likely remain a niche market and will probably remain more limited than the combat UAVs one. In fact, should research overcome all current technical issues, it would be unlikely that these technologies will be affordable for a high number of countries – especially if we consider that current MBT operators, especially in Europe, are already struggling to maintain their units efficiency and deployability. Moreover, developing combat UGVs will be so complex that only the countries who have already acquired relevant know-how in the production of MBTs will likely have the sufficient skills to develop them. ■

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Russian UGV Developments

Jörgen Elfving

In 2017, the magazine 'Business Insider' stated that the Russian Federation was the leading country in terms of armed unmanned vehicles. This is not without reason. In recent years, Russia has developed and tested a number of unmanned vehicles, including unmanned and armed ground vehicles (UGVs), which have been overshadowed, to some extent, by the attention given to UAVs, and for some of them Syria has also been a test site where they have worked with mixed results.

In Russian parlance, unmanned vehicles are robots defined as "a technical system capable of perceiving information from the surrounding and based on that information performs certain actions both autonomously and with an operator in a control loop." However, the systems are not a novelty in the Russian Armed Forces. The

radio-controlled T-34/85, albeit still without any success. What happened thereafter is less known, although an UGV based on the T-72 was tried in the 1980's. After the collapse of the Soviet Union in 1991, work on UGVs for obvious reasons tended to peter out. However, in 2000, a plan for the further evolution of UGVs

Autonomous Robotic Systems

It is clear that Russia pays great attention to the development of unmanned vehicles. President Putin realised and understood the significance of these vehicles based on his comments made in 2017: "An interesting and promising area is autonomous robotic systems. They are able to fundamentally change all the weapon systems of the general-purpose forces, and we need our own effective developments in this area as well". Furthermore, a recent article in *Armejskij Sbornik*, describing the development of tactics over time, claims that the introduction of robotic systems is one of the most important tactical developments in combat. From a Russian perspective, which has been consistent since at least 2013, UGVs perform the following roles:

- Breaking through fortified enemy positions;
- Forming 'strongpoints' in front of defensive positions in order to create favourable preconditions for defending these positions;
- Fire support for fire offensives;
- Target acquisition and fire control for the artillery;
- Bomb disposal;
- Evacuation of casualties and damaged equipment from the battlefield;
- Mine laying, mine clearance and ensuring passages through minefields;
- NBC-detection;
- Making smoke screens in areas covered by enemy fire;
- Delivery of munitions and fuel to units when under fire.

Recent Developments

These tasks are reflected in the Russian 'family' of UGVs where one source lists 37 different types developed by eight research institutes and companies. This large number is because these different types are designed to each perform one specific task. However, this number might also indicate a lack of focus in the development of UGVs.

Photo: MoD Russia



The demining UGV URAN-6 with a detachment of Russian sappers in Aleppo, Syria

1930's saw the development of a number of UGVs, among them the so-called 'Tel-etank', based on the T-18 and T-26 tanks. Although the latter was used during the Finnish Winter War from 1939 to 1940, it achieved negligible results due to its thin armour that made the UGV vulnerable. After 1945, further attempts to develop UGVs continued, among them with a

was presented, leading to the development of a number of experimental vehicles, among them another UGV based on the T-72 ALISA. Yet, despite the fact that the renewed development of UGVs was successful, it led ultimately nowhere and resulted in a situation resembling the 1990's.

A change for the better occurred in around 2010 and, in 2012, Russian Ministry of Defence's (MoD) Main Research and Testing Centre of Robotics was established. This renewed interest in unmanned vehicles also led to a committee being established for the development of robot technology in 2014 inside the MoD headed by the Minister. The same year saw a plan agreed for the further development of robot technology and, from 2016 on, annual conferences were arranged on this topic with the participation of the armed forces, industry and research institutes.

Author

Jörgen Elfving is a former lieutenant colonel in the Swedish army. From 2012 to 2016, he participated in a study at the Swedish Defence University focusing on the development of Russian military capability. He is a frequent contributor to magazines covering military issues, such as the Swedish Royal Academy of War Sciences Proceedings.

The more interesting UGVs are those that are armed, introduced in the Russian Armed Forces, tested in combat or with an interesting design, among them the following:

- **MARKER** – a tracked vehicle equipped with a 7.62mm machine gun and ATGMs and possibly intended to work in tandem with mini-UAVs or other unmanned vehicles;
- **NERECHTA** – a vehicle said to have been tested in Syria, equipped with artificial intelligence and appearing in three versions, fire support, reconnaissance or transport vehicle;
- **R-27-BT** – a further development of MRK-27, a vehicle intended for bomb disposal. It is equipped with a 7.62mm machine gun, RShG-2 rocket-propelled assault grenades and the thermobaric weapon RPO-A SHMEL;
- **R-002-BG-57, VOLK-2** – equipped with a 7.62mm, or 12.7mm machine gun, alternatively a 30mm grenade launcher. In 2014, the vehicle was tested in strategic rocket troops and guarded silo-based missiles;
- **PLATFORMA-M** – a smaller tracked vehicle normally equipped with a 7.62mm machine gun and two RPG-26, although other alternatives exist. It has participated in a number of exercises together with UAVs;
- **SORATNIK** – a tracked vehicle shown for the first time in 2016 and equipped with a 7.62mm or 12.7mm machine gun. In one version, it is augmented with a grenade launcher or ATGM, but even SAMs or a 30mm automatic gun have been mentioned as armament. In addition, SORATNIK is claimed to be equipped with artificial intelligence;
- **URAN-6** – a mine clearing vehicle used in Chechnya and in Syria equipped with different mine clearing devices and a bulldozer blade. According to Russian media, a similar and modular vehicle, KAPITAN, has been recently tested;
- **URAN-9** – a tracked vehicle equipped with a 7.62mm machine gun, a 30mm automatic gun, ATGM, and the thermobaric weapon RPO-A SHMEL;



Photo: Vitaly Kuzmin

The R-002-BG-57 VOLK-2, equipped with a 7.62mm, or 12.7mm machine gun, or alternatively a 30mm grenade launcher



Photo: Vitaly Kuzmin

SORATNIK is a tracked vehicle shown for the first time in 2016 and equipped with a 7.62mm or 12.7mm machine gun.

- **URAN-14** – a tracked unarmed vehicle with an appearance similar to the URAN-6 and fitted with firefighting equipment. In 2016, the 1st Engineer Brigade received three vehicles, while it is not known whether additional vehicles have been introduced in the Russian Armed Forces. There are also other vehicles that have received less media attention, for example, unmanned versions of the BMP-3, UDAR, VICHIR and the latest version, PALADIN, which among other UGVs, shown at the recent exhibition ARMIJA-2019. There might even be other vehicles yet unknown to a wider public.

Of the vehicles mentioned above, URAN-6 and URAN-9 are the most noteworthy. Both have been tested in Syria where it is reported URAN-9 failed to live up to expectations – although the malfunctions noted are now said to have been rectified. URAN-9 is also part of a system, comprising four UGVs, a command post and vehicles for transportation and maintenance. URAN-6 has also been introduced in the Russian Armed Forces and, during 2019, at least 12 vehicles will be procured.

However, it is not only a question of developing different vehicles. One question that still has to be answered is how to use them on the battlefield? Will they be organised in separate units or incorporated in existing units? Although this question remains unanswered, during a scientific congress in 2018, the creation of a possible UGV-battalion was announced, which is probably more an idea or a 'first draft' and arguably will not be realised in the near future. Nevertheless, it is still interesting as it reflects Russian ideas in this regard.

URAN-9 is a tracked vehicle equipped with a 7.62mm machine gun, a 30mm automatic gun, ATGM, and thermobaric weapon RPO-A SHMEL.



Photo: Vitaly Kuzmin



The heavy demining UGV PROKHOD-1

Obviously, from a Russian perspective, while UGVs are seen as ensuring success on the battlefield and avoiding casualties, information on how to employ them on the battlefield remains scarce. However, a study by Bauman University in Moscow claims to have proven their advantages. Their study compared the use of a UGV unit to that of a conventional unit, reinforced mechanised company, when attacking a platoon strongpoint that had been prepared for defence for some time. The result was that the 'conventional at-

tack' was more time consuming and result in more casualties, a result not changed even by introducing new tanks and APCs in the 'conventional unit' (i.e. ARMATA and BUMERANG). Besides this study, there are also other ideas on how best to use UGVs to support a platoon-sized assault.

As of today, UGVs do not hold any advantages due to a number of problems, a fact acknowledged at a conference in 2018 when, based on the performance of URAN-9 in Syria, a high profile participant claimed that "modern Russian combat



The URAN-14 UGV in a firefighter version



The MRK-RKh UGV for CBRN detection

UGVs are unable to perform the assigned tasks in the classical types of combat operations." The problems are mainly related to having an operator control the vehicle where she or he is separated from the vehicle and the operator's situation awareness is based on footage from the vehicle or information from other on-board sensors. Therefore, the operator's understanding of what is going on the battlefield can be flawed and the identified problems will not be solved in the coming 10 to 15 years. The solution is to give the UGVs an increased ability to act autonomously and auto-

matically identify targets as 'friend or foe', which is something accomplished by the introduction of artificial intelligence and autonomous vehicles that are said to be developed no earlier than 2030.

Artificial Intelligence

Artificial intelligence in connection with armed unmanned vehicles is a controversial issue. Will armed UGVs have the ability and be allowed to autonomously employ lethal force when detecting what is perceived as an enemy or a likely target? Concerns with regard to artificial intelligence have been voiced from time to time, and a Russian analysis of the situation, made in 2018, pointed to a number of risks: a human being not involved in the decision making cycle; the strategic balance is upset by an actor getting technical or military superiority leading to an arms race; international law is cast aside; and the shortened time for intelligence collection' and analysis implying that decisions are made based on mathematical algorithms and not on human logic. Nevertheless, Russia is pursuing research and development on artificial intelligence for military purposes with these efforts emanating from Russian views on the nature of future warfare and a fear that other international actors might make advances in this field.

Clearly, Russia has come far when it comes to the development of UGVs with the Russian MoD realising their importance. Russia has also the advantage of having tested some UGVs in one combat environment, namely Syria, which is important for their development. Their use in Syria has revealed a number of shortcomings connected with their use on the battlefield have been noted as well as insights gained to spur their further development and introduction in the Russian Armed Forces. Their introduction demands the development of TOEs, introduction of new units, tactics and training of commanders on different levels, which will all take time. The appearance of autonomous vehicles by 2030 equipped with artificial intelligence remains debatable as Russia is lacking capacities in this sector. To this must also be added the discussion – both internationally and in Russia – regarding the use of the artificial intelligence in connection with unarmed vehicles.

To judge from the Russian interest in UGVs and the development of these vehicles, it is just a question of time until they will appear on the battlefield, although not in the short-term future. Nevertheless, it might already be prudent to consider how to engage with them. Is Russia the new 'queen on the battlefield'? ■

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TRINTON EVENTS

Taiwan's Defence Market Opens Cautiously to European Sellers

Wendell Minnick

Although Taiwan is increasing its defence budget under President Tsai Ing-Wen, there are challenges faced by the international defence industry trying to ply their wares on the island.

In August, Tsai approved a defence budget request for a 5.2% increase; from US\$11Bn to US\$11.4Bn (US\$558M increase from 2019). The allocation will be divided

industry policy, mandated by Tsai after her inauguration in 2016, as part of an overall strategy to develop and build arms in-country. The policy is meant to wean Taiwan off

programmes are now the rule and any attempt at selling entire kits will be difficult. The primary message was that the international defence industry should look at support hardware and software beyond Taiwan's reach.

These plans face tough challenges. Pentagon supply chains, particularly from external supplies, are already clogged with first-class suppliers. There is also a certain prejudice against equipment that has never been battle tested. Though Taiwan might attempt to sell arms to developing countries, there are fears that some of the weapons, such as missiles, might anger the US.

Despite Tsai's strong mandate to develop and manufacture defence items locally and reduce Taiwan's dependence on unpredictable foreign suppliers, the island still has weak areas that can be exploited by overseas suppliers.

These include the Indigenous Defence Submarine programme, stealth aircraft and maritime vessel technologies, electronic surveillance and countermeasure systems, and information, communication and electronic warfare capabilities in both defensive and offensive categories. The Taiwan defence market centres around two government entities that foreign defence companies must accommodate: the Armaments Bureau under the Ministry of Defence (MoD) and the Legislature's Foreign and Defence Committee. Besides the Bureau and the Committee, foreign defence suppliers will need a locally licensed agent to represent the product and push sales.



Photo: TADTE

Taiwan Aerospace and Defense Technology (TADTE) 2019 closed out with a record attendance. Over 42,000 visitors attended this 3-day event, up 8% from the last edition.

three ways. First, US\$5.2Bn for personnel costs; second, US\$3Bn for equipment maintenance and facilities; third, US\$3Bn will go to technology in defence technology investment and training. Taiwan plans to increase the overall defence budget from the US\$11.4Bn to US\$13.1Bn in 2027. Problems for international arms dealers arise from Taiwan's new indigenous defence

its dependence on foreign-made arms. Tsai is also gambling that the high costs of indigenous weapons development will be offset by offering arms to the international market. Taiwan has already marketed its wares at the Paris Airshow and defence exhibitions in Asia, including DSA in Malaysia.

Indigenous Programmes

Taipei Aerospace and Defence Technology Exposition in August 2019 communicated the same message to international arms marketers eager to fill Taiwan's military requirements with every gadget and gizmo imaginable. That is, indigenous build pro-

Procurement Scandals

Without the proper introductions to government bodies, via only the local agents, little of anything can be accomplished. The government is paranoid of becoming involved in scandals that have rocked the MoD over the past thirty years.

Author

Wendell Minnick is a defence and security journalist specialised in military and security issues in Asia.

This paranoia was fostered and later set in stone after the 1991 sale of six LAFAYETTE frigates that led to a scandal that resulted in numerous mysterious deaths and around US\$500M missing. Though corruption still exists within Taiwan government institutions, the frigate scandal, as well as a missing funds scandal involving the purchase of 60 Dassault MIRAGE 2000-5D/E fighter jets in 1992, seriously damaged European opportunities in Taiwan's defence market.

American Suppliers

Because of the close relationship between Taipei and Washington, the main defence suppliers are American. However, there have been some European success stories in the recent past, including Eurocopter and the Indigenous Defence Submarine (IDS) programme. Though for the most part, the MoD prefers to deal directly with the US Defence Security Cooperation Agency's (DSCA) Foreign Military Sales (FMS) Programme Office. Taiwan's military brass believes that the FMS programme is more transparent and therefore politically safer.

In 2019 alone, Taiwan secured a US\$8Bn package for 66 new F-16V Block 70 fighter aircraft, with an estimated 30% offset opportunities for technology transfer, domestic procurement and personnel training. The US also released a US\$2Bn deal for 108 refurbished M1A2 ABRAMS main battle tanks (MBT) from the US to replace its ageing M-48/M-60 PATTON MBTs.

US defence companies have a powerful ally that facilitates military sales to the island. The DC-based US-Taiwan Business Council should be renamed the "US-Taiwan Defence Council", as it does little else than promote arms deals.

In May of each year, the Council and the Taiwan Defence Industry Development Association (TW-DIDA) co-host the Taiwan-US Defence Business Forum. This conference is the ultimate meeting for networking, and though it is billed as a US business and government "tier one" event, European defence companies are also in attendance.

Taiwan's Minister of Defence and other senior military leaders are normally in attendance. The head of the US DSCA and other US military organisations, along with CEOs of major defence companies, pack the event.

There are other important organisations that foreign defence industrial newcomers must connect with, depending on their area of expertise. These include the Taiwan Aerospace Industry Association, Taiwan Space Industry Development



European companies have been slow to enter the Taiwanese defence market.

Association, Taiwan Drone Association (TDA), and the government-run Committee for Aviation and Space Industry Development (CASID) under the Ministry of Economic Affairs.

Taiwanese companies, including government-owned, that produce military equipment are the Aerospace Industrial Development Corporation (AIDC), National Chung-Shan Institute of Science and Technology (NCSIST), and China Shipbuilding Corporation (CSBC). Partnering with these entities is a common strategy of foreign defence companies looking to penetrate the market.

Local agents are required as direct sales to the MoD are largely unheard of without them. The most famous and reputable is U&U Engineering, Inc., which undergoes numerous due diligence and stress checks via the US de facto embassy in Taiwan, the American Institute of Taiwan (AIT). Check with AIT's Commercial Section for assistance.

Advice for European Companies

Competition via Japan and Singapore for what was once considered Western domination of advanced defence technologies now appears gone. Advice for European competitors? Hard-to-find components and systems are the best pathway to securing Taiwan arms deals. Looking for opportunities within the export restrictions the US government enforces on Taiwan has proven effective in the past.

Advice on visiting Taiwan should be carefully coordinated with your local agents. Never during Ghost Month, when business

deals are cursed to fail. Forget visiting during the long Chinese New Year. The days these holidays fall on can be confusing due to the quirky lunar calendar; so double check.

Customs include gift giving such as bottles of spirits, golf and dinners as business expenses. Avoid Karaoke (KTV) Bars where the girls can provide "special services" all recorded by ceiling security cameras. If there are problems, contact the local embassy's regional security officer on no-go areas.

Despite US dominance, European companies have had some success.

In 2010, Eurocopter secured a US\$111M deal for three EC225 medium-lift helicopters for search and rescue missions (SAR) for Taiwan's air force. The deal included a future option for additional aircraft. The announcement created a shock amongst US defence contractors in Taipei, beating US-based Sikorsky's S-92 HELIBUS. Sikorsky has had a long relationship with Taiwan's military that included the S-70C helicopter for the air force's SAR missions and the navy's anti-submarine warfare missions. The S-92 disaster does not appear to have deeply damaged Taiwan's relationship with Sikorsky. Taiwan's army later selected the Sikorsky UH-60M BLACKHAWK to replace its aging UH-1H HUEY fleet.

Tsai's domestic defence build policy did destroy a 2014 deal between AIDC and Leonardo-Finmeccanica to co-build the M-346 Advanced Jet Trainer (AJT) for the air force's requirement for 66 aircraft to replace aging AIDC AT-3 TZU CHUNG attack/trainers and F-5 Tiger fighter trainers. The deal included a teaming agreement for the transfer of technology, co-production and technical assistance.

At the time, Taiwan's AIDC did not appear to have the expertise needed to design AJT. However, AIDC was conducting upgrades for the Indigenous Defence Fighter (IDF) and has since used the same design parameters to develop a local replacement for the AT-3/F-5s. Operational deployment is scheduled for 2026. Midlife upgrades for its remaining 142 F-16A/B Block 20 and AIDC F-CK-1 CHING-KUO Indigenous Defence Fighter (IDF) fighter aircraft procured from the 1990s are ongoing and offsets have already been allocated.

The area of naval indigenous programmes there are big problems. Taiwan's minelaying vessel faces delays due to a 2017 corruption scandal involving Ching Fu Shipbuilding in late 2017. Taiwan's navy has a requirement for six vessels under the Project Kuang Ping (Phase III). The 700-ton vessel's blueprint include OTO Melara 72mm gun and mine detection hardware provided by Lockheed Martin.

Taiwan's Submarine Programme

Taiwan's Indigenous Defence Submarine (IDS) programme is now cracking on after almost two decades of inertia. However, the effort has raised eyebrows in Taipei media and political circles due to the strange origins of the consultancy hired for the programme. The programme is a lesson on how many hoops the European defence industry must jump through to avoid angering Beijing.

The IDS programme has become an all-European joint venture with China Shipbuilding Corporation (CSBC). Tsai's policy to build 8-12 IDS platforms, with plans to continue builds for the export market, faces serious competition on the international market from European and Russian builders, and there are real fears an indigenous build of a complex platform like a submarine would face serious safety issues.

Few countries in the region are in desperate need for submarines built by Pilgrims. The Europeans and Russians offer regional countries opportunities not only for rugged attack submarines, but also co-build options and technology transfer.

The European angle is demonstrated by the creation of Gavron Limited, which is registered not in Taiwan, but on Gibraltar on the Iberian Peninsula. Though a British Overseas Territory, the outcrop is well known for business activities outside the sphere of normality. According to Gavron's website, its role in the IDS is "to review submarine concept designs to assess technical balance and safety." Taiwanese employees are not identified,



Photo: TADTE

Problems for international arms dealers arises from Taiwan's indigenous defence industry policy which is meant to wean Taiwan off its dependence on foreign-made arms.

but the head of Gavron is described in a local media report as a man with ties to a former senior officer in Taiwan's navy. Local media reports are full of conspiracy and innuendo about Gavron, including suggestions that senior Taiwan managers are tied to the infamous LA FAYETTE scandal. Though the website states it has six employees, only four are identified – all European with strong submarine experience. They include Juan Errero Valero, who is the leader of the IDS technical advice team and substructure engineer. Previous experience includes Spain's S80 submarine for Techno Pro Hispania and Sirena. Darryn Ambage is the IDS principal systems engineering consultant. Past employment includes UK Ministry of Defence, BMT Defence Services, AMEC and Sellafield, and ten years in the Royal Navy Submarine Service. Jim Fishburn is the IDS project lead. Before Gavron, Fishburn worked for Qonect International Consulting and KCOM in telecommunications, with a 24-year career in the Royal Navy.

Vincent Quigley is the IDS combat systems integration engineer. Previously, Quigley worked for RB Safety Consultants on the United Kingdom 'Future Submarines Whole Boat Spatial Governance' assurance checks of the tactical weapon system for Astute-class submarines and combat systems group, common missile compartment and strategic weapons project team. Quigley served in the Royal Navy as a submarine weapon engineering manager, including as a crewmember of the HMS ARTFUL.

Areas that Taiwan has some limited capabilities, and European companies might take advantage, include high-performance surface vessels, air-dropped sea mines, enhanced minelaying capabilities, unmanned vehicles/vessels for both air and sea, upgrades for older naval ships, air defence missile capabilities, long-range strike firepower (anything that can cross the Taiwan Strait, i.e. 130-220 km), and shore-based mobile missile technologies.

Specialty areas that enhance Taiwan's ability to tip-toe across the razor's edge of the Missile Technology Control Regime (MTCR) are possible. The MTCR has been violated by China with the development and fielding of cruise missiles and unmanned aerial vehicles that violate its restriction of delivering a payload of 500 kg and ranges of 300 km. Though Taiwan continues to adhere to the MTCR, while facing off with an enemy that has clearly violated every term of the agreement, Taipei is not a signatory.

European companies must also contend with Beijing's lobbying efforts within the European Union (EU) to stop all contact with Taiwan. Contrasting the billions spent on trade between China and the EU, a multi-million-dollar defence contact with Taiwan seems puny and unnecessarily dangerous in economic terms.

The European Chamber of Commerce – Taiwan (ECCT) can be of helpful, as well as their de facto embassies. Warning: steer clear of non-governmental organisations that contrive their influence. The most infamous is the European Business Association in Taiwan (EBAT).

“The autonomy definitely has to increase.”



Since the 1980s, Texttron Systems has been designing, manufacturing, operating and supporting some of the world's most reliable and trusted multi-mission tactical unmanned aircraft systems (TUAS). European Security & Defence had the opportunity to speak with David Phillips, Texttron Systems' Senior Vice President & General Manager, Unmanned Systems.

ESD: SHADOW is probably Texttron Systems' best known and best established TUAS. Can you elaborate on the system and its capabilities?

Phillips: SHADOW is a programme of record for the US Army for a tactical unmanned vehicle. They – the US Army – have over 100 SHADOW systems deployed in their formations now. Most of them are in Brigade Combat Teams (BCT), but they are also in Combat Aviation Brigades. A lot has been done with SHADOW to team with manned aviation: partnering with APACHES, being their eyes and ears and then sending the information directly into an APACHE cockpit to allow them to do targeting and things like that.

SHADOW is not runway independent in the strict sense of the word. It does take off with a catapult launch system, but it needs something like a soccer field to land. Initially, when SHADOW was fielded – this is our twentieth year of operating with the US Army – the specification was for a system that did not need a lot of dedicated infrastructure. There are soccer fields anywhere in the world. So, as long as you can land on a soccer field, you are good, you don't need runways, you don't need improved sites – just a soccer field. SHADOW was designed for an arresting gear type of landing. It has an automatic millimetre wave control that automatically brings it to its glide path and lands it. Then, the arresting hook grabs it – like on an aircraft carrier. That is not what the US Army

now calls runway independent, but it is small and does not need much to operate (i.e. tactical).

SHADOW has about a 10-hour endurance, depending on the payloads that it carries, of which there are a wide variety that the system can accommodate. SHADOW was originally called the SHADOW 200, because it weighed 200 pounds. If we named it the same way now, it would be the SHADOW 500. So, while SHADOW has grown over the years, the engine has stayed the same. That becomes challenging. It takes longer to get to operational altitude, and you are burning fuel when the system is not yet on station.

SHADOW has recently been going through a block upgrade, which has been simply named SHADOW Block III. We just completed testing with the US Army at White Sands Missile Range. It has a new, quieter engine with 25% more horsepower to accommodate the weight increases over the years. Since the SHADOW engine tends to be criticised for being loud, the new engine has a reduced audible signature, alleviating those concerns. It was not a purpose-built engine back when SHADOW was designed; we converted it to its current purpose.

ESD: What altitudes does SHADOW operate?

Phillips: I shall say the specification is 16,000 ft density altitude. But most of our requirements are lower, based upon the payload in use. However, sometimes, you are working over mountain ranges where your floor may be 8,000 to 10,000 feet high. Then, you still want to be out of audible and visible range.

ESD: This is why I am asking – if the noise of the engine is a factor ...

Phillips: If the noise of the engine is a factor, then you want to fly higher. But the new engine gives SHADOW a much lower acoustic signature. It is water-cooled and has just under 50 hp. That's a big improvement for SHADOW. We also have a new high definition electro-optic infrared sensor and a 10-inch gimbaled payload with laser designation, which is an important element of what SHADOW does – e.g. during manned-unmanned-teaming. It has improved weather performance. SHADOW often was limited when it was extremely cloudy or precipitating. It was only rated at a quarter of an inch of rain per hour, which can still be called “standard” for that size



Photos: Texttron

The SHADOW TUAS designed by Texttron

of aircraft, but now it is 2 inches of rain per hour. So, we can operate better in clouds or in and out of clouds.

The payload is probably the biggest change that the user is going to see, because it enables you to fly higher and still get high definition with greater stand-off distances. So, SHADOW will be even more covert in the way it operates. SHADOW has a lot of payload capability. It can fly various electronic warfare payloads, though the basic missions for SHADOW require a good EO/IR payload, some element of ability to team with manned aviation and to pass control of SHADOW to entities outside the system itself. We have what is called a "Level of Integration 3" capability in SHADOW where you can pass control of the payloads off to remote users, even to somebody with an Apple or an Android device. SHADOW's full motion video can be viewed on a soldier's Android device using a secure app. After a series of security protocols, the soldier can see what the SHADOW sees.

ESD: Can APACHE do the same?

Phillips: APACHE can do the same – in fact, APACHE can control the payload. Through a set of authorisations, a SHADOW operator can give an APACHE crew control of the payload. They can then determine – basically by touch screen – where the sensor is going to look. This will give them a picture of places where they cannot go themselves because it may be too dangerous.

ESD: Is there anything more you would like to say about manned-unmanned teaming?

Phillips: We pretty much covered it. Generally, when we say manned-unmanned teaming, that has this meaning to the in-



The NIGHTWARDEN UAS is an upgrade of SHADOW.

dustry. We aim to partner a TUAS with a manned asset to have the TUAS perform the dangerous activity, letting the manned aviation stay at a safe distance. How this is done in detail, is covered by Army tactics and doctrine.

ESD: I understand. So, what is the difference between SHADOW and NIGHTWARDEN?

Phillips: NIGHTWARDEN is a SHADOW upgrade. It has about 75% commonality with SHADOW. It was our own, company-funded development that was intended to give SHADOW users additional capability – primarily satellite communications (SATCOM). We redesigned the fuselage to enable us to put a satellite dish inside, allowing us to extend the range of communication to and from the aircraft significantly. It also has a much larger payload bay to enable more fuel, so that we can take advantage of SATCOM and operate at greater distances

from the controlling entity. You might say that NIGHTWARDEN is like a small GREY EAGLE or a small PREDATOR, able to do SATCOM-controlled missions, but in a much smaller form factor. We call it a tactical, organic unmanned air vehicle with similar capabilities as theatre assets like PREDATOR or REAPER, which don't belong to the tactical unit.

ESD: So, NIGHTWARDEN is not currently looked at by the US Army?

Phillips: Not at this time. Therefore, NIGHTWARDEN has focused on the international market. Not just for international SHADOW users, but also for someone who wants an affordable, satellite-capable unmanned aircraft system that can carry a high definition electro-optics payload.

Now, since you asked about the US Army, they are defining a future TUAS. This must be runway independent and they are not as worried about SATCOM. They care about ease of deployment and transportability. The US Army has selected our AEROSONDE in its vertical take-off and landing (VTOL) version for their future tactical programme which is their future expeditionary small unmanned aircraft system. AEROSONDE is probably flying most prevalently of all unmanned systems in the world right now. It is flying over 10,000 hours a month for our defence services, including Special Operations, US Army, US Navy and US Air Force. The VTOL version, the AEROSONDE HQ, is a fixed-wing VTOL, so it is the best of both worlds. It has the endurance of a fixed-wing aircraft, but also the flexibility and the take-off and landing capability of a VTOL aircraft. This is good for the US Army, but it is also special for the Coast Guard and the US Navy. Small ship decks and helicopters do not work well with launch and recovery equipment for unmanned aircraft systems, as they can cause interference with the helicopter's rotor blades.



The AEROSONDE HQ is a fixed-wing VTOL.

The US Army is going to evaluate our VTOL AEROSONDE. They will buy several systems and field them with designated BCT's. During this trial period, the users will figure out how they can use them and develop a concept of operations. The whole system, plus a crew of four that can operate 24/7, fits inside a CH-47. So, it's very transportable and deployable. We can unload from the CH-47, assemble the aircraft and launch it in under 18 minutes.

ESD: And the ground station will be operational, too?

Phillips: Yes, the entire system is loaded onto a standard 463L pallet. The crew of four unloads the pallet, pulls everything out, charges up the ground control station, assembles the wings, gets the engine going and launches it under 18 minutes. The US Army is looking for a small, capable, deployable system that can react quickly. That's why they selected AEROSONDE.

ESD: How do you see the future, what developments and perspectives do you see?

Phillips: I have always believed that the most apparent use of UAS is in the maritime domain. We are doing a lot of work in that arena and currently have a contract

with the U.S. Navy to deploy AEROSONDE with a ship. When you think about situational awareness either for a fleet or a single ship, just think about the advantages you could get from an UAS being able to operate in a 140 kilometre range from the ship. Being able to operate a VTOL version of an UAS on a small ship will give that ship an unparalleled capability that it just did not have before – that opens up its whole area of surveillance. I am excited about that and the future of our systems onboard ships.

I am also excited for a future system that works with vectored thrust. And this system would also be all-electric. Instead of flight control surfaces, the aircraft would just have a single wing and have controllable elevation and altitude through four vectored props. This system would be able to take-off and then to transition to flight all-electric. The problem of all-electric propulsion is endurance. Therefore, for the meantime, the system will still have a combustion engine – not to produce thrust, but to produce electricity. We can then have an all-electric powered UAS that gets past the problem of endurance. We are investing in that, too.

ESD: With regards to the degree of autonomy that your systems have now, would you say that it is fine fit for purpose or does it have to be improved?

Phillips: The autonomy definitely has to increase. For us to operate under FAA (Federal Aviation Administration) rules, which would allow us to open up the whole commercial market for our size aircraft, we have to invest in systems that allow the operation of UAS in controlled airspace. So much work still has to be done in detect, sense and avoid technology. A UAS has to be able to determine autonomously if something is on its flight path and decide to take an alternative course to avoid collision with another aircraft or structures on the ground. You cannot depend on the operator, who is looking at a screen. There has to be something else. Whether that will be transponder, radar or optical sensor is still unclear. The problem has been having that level of autonomy 24/7, all-weather or in the dark. If we don't get this into these kinds of systems, the FAA is not going to allow us to operate under General Air Traffic rules alongside other airspace users.

**The interview was conducted by
Ulrich Renn**



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MSPO 2019: Polish Armed Forces Continue Modernisation Efforts

Michał Jarocki

This year's edition of Poland's International Defence Industry Exhibition (MSPO) in Kielce brought a number of local and foreign manufacturers to present their newest technical solutions, designed to meet the requirements of potential customers in the demanding Central and Eastern Europe region. A wide range of weapon systems, including wheeled and tracked land platforms to rotary- and fixed-wing aircraft were showcased, as well as most modern anti-tank and air-and-missile defence systems, which will shape the posture of modern battlefield for years to come.

Polish Armed Forces and their modernisation goals were on the main agenda throughout the entire show. A number of major players in the global defence industry presented their products and sale offers for Poland, trying to reach out to main political and military decision makers in the country.

Photo: Michał Jarocki



The WARMATE Loitering Munition

WB Group, one of the largest defence manufacturers in Poland, presented at MSPO some new variants of its renowned and battle proven WARMATE loitering munition system. This included a tube launched version developed in partnership with the German Rheinmetall.

The tube launched WARMATE TL features a number of technical enhancements, including a folding wing structure, which makes the platform capable of fitting into a special transport canister. The system can be launched pneumatically from a tube, mounted on virtually any kind of wheeled and tracked drive platform. In result of cooperation with Rheinmetall, the system was integrated with the MISSION MASTER unmanned ground vehicle. A prototype of this design was showcased on Rheinmetall's stand in Kielce.

WARMATE TL features a warhead equipped with a daylight and thermal cameras, thanks to which the potential

WARMATE TL has a wingspan of 1.7m and a length of 1.1m. Max take-off weight is 4.5 kg, including a 1.4kg warhead. The system reaches a maximum speed of 150km/h. It has a range of 10km and max operational endurance of up to 40min.

ground-based target could be assessed long before the order to strike is given. Additionally, a number of fail-safe mechanisms allow for the mission to be easily aborted at any time.

The manufacturer states that the platform distinguish itself by high targeting accuracy, ability to use interchangeable warheads, including surveillance and observation, which are equipped with a special parachute system allowing for safe landing and recovery of the UAV, as well as its low acoustic trace, and high performance.

The manufacturer informed that partnership with Rheinmetall was established as a result result of a profound evaluation of the ways in which both companies could strengthen their cooperation in order to offer a not needed jointly developed weapon systems, enhancing their position on local and global markets.

WB Group's representative stated that both companies would like to broaden their cooperation, and intend to look for other possibilities of integrating WB Group's combat and surveillance systems with Rheinmetall's manned and unmanned platforms.

The manufacturer also showcased at MSPO a model of WARMATE V small multi-rotor VTOL loitering munition system. It was developed specifically to operate in dense urban environment. It is designed to detect, locate and engage enemy targets, which might be hiding in proximity of or inside buildings or other urban infrastructure.

The system is described as an alternative to common fixed-wing loitering munition systems. It is supposed to be ideal to operate in places where the use of classic, fast, and difficult in manoeuvring in urban terrain UAVs is impossible, or less efficient.

Author

Michał Jarocki is an independent, Warsaw-based defence expert who has reported on security issues and developments from a qualified "insider" position for many years.

Mobile Air Defence System from Poland

The Lukaszewicz – PIAP Institute showcased at MSPO a technology demonstrator of a mobile air defence combat system (ASBOP–PERKUN). The platform was developed in partnership with the Telesystem-Mesko company, which is the member of the Polish Armaments Group (Polska Grupa Zbrojeniowa) holding.

The manufacturer states that ASBOP–PERKUN ‘is a combination of a high level tactical mobility and rapid reaction, allowing for detection of various kinds of aerial threats, such as missiles, UAVs, rotary and fixed wing platforms’. The system is composed of a launcher with two GROM/PIO–RUN air defence missiles from Mesko, fitted on the six-wheel chassis of the IBIS robot from the Lukaszewicz – PIAP Institute.

The platform has an independent drive for each wheel, allowing it to operate in challenging and varied terrain. It is capable of reaching a top speed of up to 10 km/h. The suspension system was especially designed to ensure optimum wheel contact with the ground, improving its stability while detecting, following, and countering aerial threats.

The PERKUN robot utilises its onboard detection systems to identify and locate potential threats and lock onto targets. This can also be done by the constant exchange of tactical information with friendly platforms, like other air defence UGVs or radar/observation stations. The system is also able to receive and analyse IFF data in order to differentiate friendly and enemy combat aircraft.

According to the manufacturer, a single operator will be able to control up to 4 PERKUN robots at a time. However, the number of platforms integrated into one air defence system will depend on the wish of a particular customer, as well as mission requirements.

The Lukaszewicz – PIAP Institute acknowledged at MSPO that the ASBOP–PERKUN platform requires more conceptual and design work, enhancing its performance and operational capabilities. Subsequently, the system will undergo a series of trials, which will prove its efficiency and overall usefulness. In its current variant, the ASBOP–PERKUN is designed as a typical air-and-missile defence system, which is able to operate either in a static, or on-the-move mode. It will detect, identify, and engage a wide range of aerial threats, such as fixed- or rotary-wing platforms, missiles or UAVs, providing protection of critical infrastructure or allied forces on the move. The manufacturer also states that it has plans



Photo: Michal Jarocki

Rheinmetall presented a variant of its MISSION MASTER UGV integrated with WB Group's WARMATE TL launch system.



Photo: Michal Jarocki

This UGV system shown in Kielce is a technology demonstrator, which took PIAP and Mesko just a couple of weeks to complete successful integration. Launcher, drive platform and other components are already tested and proven.

to also develop an anti-tank variant of the system.

As much as the Lukaszewicz – PIAP Institute and Mesko are dedicated to supplying the Polish Armed Forces with modern, universal weapon systems, both partners have an expectation that the ASBOP–PERKUN will draw much attention from potential export clients and might become an alternative to the popular man-portable air-defence systems, which are costly in use and require fielding the operator in direct proximity to the potential area of attack.

LEOPARD 2PL Showcased

The most modern prototype of the modernised LEOPARD 2PL main battle tank (MBT) was presented for the first time at MSPO by ZM Bumar-Labedy, a member of the PGZ holding. The vehicle is an extensive modification of the 2A4 variant.

According to the manufacturer, the list of improvements introduced in this variant includes: an enhanced efficiency of sighting system achieved, among others, by the introduction of 3rd generation cameras for the commander and gunner, improved ballistic

protection of the turret, a digital stabilisation system installed in place of the hydraulic module, upgraded fire extinguishing and suppression systems, a new Auxiliary Power Unit (APU) unit (17 KW), new turret-located storage compartment for the crew, customised towing-evacuation system adjusted to the greater mass of the vehicle, modernised

ponents, which were not even included in the modernization plan, and therefore, were not upgraded or overhauled for years. It seems that the Polish MoD has also to take some blame for the delay, as it had stalled the programme by the introduction of additional modernisation requirements, already after the project was launched.

Photo: Michal Jarocki



The modernized LEOPARD 2PLs and ex-German LEOPARD 2A5s will become the core of the Polish Army's MBT fleet for years to come and allow for replacement of legacy Soviet-era vehicles. This gradual shift to Western-designed tank platforms is just a beginning, as Poland has already announced its intention to procure a fleet of next-generation MBTs.

main gun system, adapted to use of new types of ammunition (DM63 anti-tank and DM11 multipurpose) and driver's day-night cameras. The vehicle will also feature a new fire control system.

At the end of 2018 a handful of LEOPARD 2PL prototype vehicles was delivered to Poland. Shortly after, they went through the initial phase of field trials, which were supposed to evaluate operational capabilities and efficiency of those platforms, as well as to confirm that upgrades implemented by Rheinmetall, as the main industrial partner, met the requirements of the Polish partner. During these field trials a number of technical issues were identified, which required the implementation of necessary improvements. In result, the LEOPARD 2PL modernisation programme has already reached a several month long delay.

Most of the defects resulted from the breakdown of particular sub-systems, while others were related to failure of legacy com-

A full fleet of 142 Polish LEOPARD 2A4 MBTs is expected to undergo modernisation in the coming years. The upgrade is performed by a consortium of PGZ and ZM Bumar Labedy, which partnered with the German Rheinmetall. The programme is supposed to run through to 2021, when the final batch of modernised LEOPARD 2PL MBTs is expected to be delivered.

The LEOPARD 2PL will become the core of the Polish Army's MBT fleet in the near future and allow for gradual phase out of legacy T-72 and PT-91 platforms, despite the fact, that the former will undergo a limited upgrade in the coming years. However, Poland has already announced its intention to procure a series of new generation MBTs under the WILK programme. This initiative calls for the acquisition of a number of main battle tanks, designed either independently, which is rather unlikely, or in cooperation with foreign industry and state partners.

Poland to Buy F-35s

Lockheed Martin presented in Kielce a full-scale mockup of the F-35 5th generation multirole fighter jet. The model was showcased with insignias of the Polish Air Force, which signified the wish of the American manufacturer to sell these aircraft to Poland and confidence, that the final acquisition is just a matter of time.

Shortly after the MSPO, and after months of deliberations, Poland took a big step towards the long awaited acquisition of a new fleet of combat aircraft, as the US State Department approved the sale of 32 F-35A LIGHTNING II multirole fighter jets. According to the Defence Security Cooperation Agency (DSCA), an organisation which oversees sales of US military equipment abroad, the future contract for a Polish 5th generation fighter aircraft is valued at US\$6.5Bn. However, the price will most likely be reduced during the negotiation process.

The future contract calls also for the delivery of a number of auxiliary components, such as: 'thirty-three Pratt & Whitney F-135 Engines, Electronic Warfare Systems, Command, Control, Communications, Computer and Intelligence/Communications, Navigation and Identification, Autonomic Logistics Global Support System, Autonomic Logistics Information System, Full Mission Trainer, Weapons Employment Capability and other subsystems, features, and capabilities, F-35 unique infrared flares, reprogramming centre, F-35 Performance Based Logistics, software development/integration, aircraft ferry and tanker support'.

Furthermore, the Polish MoD has also requested delivery of 'support equipment, tools and test equipment, communications equipment, spares and repair parts, personnel training and training equipment, publications and technical documents, US Government and contractor engineering, logistics, and personnel services, and other related elements of logistics and program support'.

The acquisition of Polish F-35 fighter jets will most probably be finalised through the Foreign Military Sales (FMS) procedure. This means that the US government will get involved in the process. It is also expected, that US Armed Forces will play a part, providing training and logistical support in the initial phase of the project.

The future F-35 multirole fighter jets will be procured under the Harpia programme, which was launched by the Polish MoD late last year. It calls for modernisation of Polish Air Force's inventory, by

the acquisition of a fleet of 5th generation combat aircraft, which will enhance the country's defence capabilities.

Initially, the selection of the preferred fixed-wing platform was supposed to be done through an international open tender procedure. However, in early 2019 the MoD announced its intention to omit this process and unilaterally selected the US-manufactured F-35 fighter aircraft from Lockheed Martin as the platform of choice. It was later explained, that the department made an analysis of all fixed-wing combat aircraft available on the market, and came to the conclusion that the F-35 was the best option.

The question remains, if the decision to pass on the open tender procedure, wasn't actually detrimental. Even if it were to lead to the conclusion that F-35 is the system of choice, a competitive selection process would most likely require all bidding parties, including Lockheed Martin, to enhance their offers, for example by lowering the acquisition cost or add more benefits to the future deal, in order to attract the Polish MoD.

It is expected that the first batch of sixteen F-35 fighter jets could arrive in Poland by 2026, with another one following a couple of years later. Furthermore,



Photo: Staff Sgt. Jensen Stidham, USAF

Shortly after MSPO the US Department of State approved the long awaited sale of 32 F-35 fighter aircraft to Poland. Deliveries are expected to commence by 2026 and run through to 2030. The final fleet of Polish F-35 fighter jets might grow to 48, corresponding to the same number of currently operated F-16C/D Block 52+ aircraft.

the Secretary of State at the Polish MoD, Wojciech Skurkiewicz, has already announced on several occasions, that Poland might intend to acquire additional

aircraft in the future, increasing the F-35 fleet to 48 platforms, which would correspond with the same number of currently operated F-16C/D Block 52+ fighters. ■

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“I am proud that we have saved so many lives.”



Photo: Nurol Makina

Nurol Makina was founded in 1976 to provide turnkey industrial services. After establishing the Presidency of the Defence Industry (SSB) in Turkey, Nurol Makina started its activities in the defence industry. The company aims to expand its business in both domestic and foreign markets. ESD had the opportunity to talk to Mr. Engin Akyol, CEO of Nurol Makina.

ESD: Nurol Makina is a manufacturer of armoured vehicles, with the EJDER YALCIN 4x4 and NMS 4x4 models being particularly noteworthy. What are the differences between the two models and between them and their competitors?

Akyol: Both the EJDER YALCIN 4x4 and the NMS 4x4 vehicles differ significantly from the competition and offer users unique advantages. The main difference is that they are both multi-purpose vehicles and offer an excellent combination of protection and mobility in a sustainable way due to their high reliability and low cost. Allow me to clarify this statement.

As multi-purpose vehicles they can be used for various missions such as combat, air defence, command and control, surveillance and reconnaissance, forward observation, personnel transport, EOD, medicine, etc. The use of a single vehicle for such a large number of missions significantly reduces maintenance costs for users. Please note that these two vehicles are proprietary Nurol Makina designs and we have all the design, development and production expertise to adapt vehicles with shorter lead times and development costs to the individual needs of users.

Their proven status underlines the high reliability of these vehicles in their segments. In the event of a conflict, even a slightly improved detail in the ergonomics, reliability or functionality of the vehicle can save your life. In designing these vehicles, we have taken into account the experience of the armed

forces and security forces in various combat zones. EJDER YALCIN 4x4 was put into service in 2014 based on feedback from users, we have continuously improved the vehicle. The current version of EJDER YALCIN is actually called Block IV. And NMS 4x4, a lighter and more agile version of EJDER YALCIN, is also being developed taking into account all the design, development and field experience of EJDER YALCIN.

Let me also clarify what I mean by a better combination of protection and mobility. EJDER YALCIN offers the highest mine, IED and ballistic protection achievable in this segment, i.e. a level of protection almost like a MRAP vehicle. There are some other armoured vehicles that offer a high level of protection like MRAPs, but they are not as good in terms of mobility characteristics and are mostly used as troop transporters. In contrast, EJDER YALCIN has extremely good off-road performance. EJDER YALCIN has been tested in 11 countries under very different and demanding environmental and geographical conditions and has achieved excellent results in all these tests. This makes EJDER YALCIN a proven all-weather all-terrain vehicle.

ESD: The NMS 4x4 strikes an intelligent balance between protection and range through additional armouring. Depending on the application, ballistic security levels from 1 to 4 can be achieved. So how will you handle this tension between protection and weight in the future?

Akyol: In fact, the NMS 4x4 brings a new level of mobility and protection. As you mentioned earlier, it is possible to balance mobility and protection. We manage this trade-off by applying a scalable armament system to NMS that gives users the flexibility to adapt the ballistic protection level to the threat at different times and occasions. Users do not need to wear additional armour plates at all times to protect them from kinetic attacks

during a conflict. It is only when the vehicle is on a mission with a risk of conflict that additional armour plates can be mounted on the vehicle in accordance with the threat level. Compared to EJDER YALCIN, NMS is a lighter vehicle and offers even higher speeds and agile on- and off-road performance.

ESD: At our last meeting in 2017, Nurol Makina had a strategic plan for sustainable growth from 2018 to 2022. One of the goals was to invest more in technology than in production, but today you are producing more than before. Production Lifecycle Management was also on your agenda. How do you deal with the complex value chain and suppliers?

Akyol: I prepared the first strategic plan for 2012 right after I started at Nurol Makina and we have constantly revised it to reflect the changing global and industrial dynamics. As you have already indicated, our strategy is strongly based on investing in technology, not only in our products and services, but also in our building infrastructure. Although our production rates are significantly higher than a few years ago, there is no change in this policy. The increase in the production rate is an inevitable result of the increased expectations of customers. However, I must stress that every year we outsource more and more by building long-term strategic suppliers. We focus on design, development, testing and assembly. For manufacturing, we rely mainly on our suppliers. In Turkey there are competitive and efficient suppliers who meet our requirements. In addition, we also cooperate with local manufacturers in our customer countries. Currently we are even working on setting up an assembly and testing facility in a European country where we will use manufacturers from this country and some neighbouring countries.

Furthermore, we have been constantly investing in new technologies like new ERP and PLM software as well as in hardware

to increase automation like robotic welding machines, highly precise CNC controlled laser cutting machines.

In this highly competitive and connected business environment, efficiently managing an international supply chain requires special attention indeed. Thus, we have a well-organised multi-disciplinary supply chain management team, composed of highly experienced and talented staff.

ESD: Nurol Makina has set itself the target of exporting US\$100M each year as of 2023, the year in which the Republic of Turkey celebrates its centenary. Given the current order backlog, can we expect you to reach your 2023 targets ahead of time? What is the ratio of export strength to domestic turnover? Are there any new markets you would like to enter?

Akyol: Years ago we set ourselves an export target of 100 million dollars, and I am proud that we reached this level a few years earlier. Export accounts for most of our sales, which is a prerequisite for corporate sustainability. And I can tell you it keeps our organization fit. That is, to meet the expectations of different customers with different threats, geographic conditions, and military security infrastructure, we need to conduct agile business development activities with users who are strongly supported by organisational functions back in our facility.

We are definitely targeting new markets, but unfortunately I can't name them. However, I can tell you that these potential countries are not only in conflict zones, although we offer battle-proven, highly protected vehicles. You can imagine our vehicles as a 30-year insurance policy, just as we need insurance because we have accidents every day. We can have an accident once in a few years, but it is nice to know that we have an insurance policy at hand. In such a fast and chaotic changing world, even countries with less risk-related conflicts are now interested in our vehicles for future uncertainties. As you know, these are not small investments and lead times are relatively long, so you need to plan for acquisitions with foresight.

ESD: Which current trends will you take into account in the future development of military vehicles?

Akyol: First of all, I would like to say that I am proud that we have saved so many lives of armed and security forces so far. That is the most valuable part of our business and indeed defines our mission. However, there is no saturation point in offering best solution in terms of protection, as new threats and technologies evolve and emerge. Therefore, we continue investing in increasing protection features of our vehicles. This involves



Photo: Nurol Makina

The EJDYR YALCIN is a combat-proven all-weather all-terrain vehicle.



Photo: Nurol Makina

The light armoured vehicle NMS 4x4 weighs eight tonnes and is capable of carrying up to four tonnes.



Photo: Nurol Makina

At Nurol Makina, the focus is on digitisation, interoperability and communication as future core requirements for armoured vehicles.

reliability improvements as well as including new technologies to our vehicles like active protection systems. Increasing vehicle agility is another crucial issue against evolving threats. We work with best in class suppliers in the world for engine, transmission and axles, and making extensive development and improvement studies with them. Our passion as Nurol Makina is to offer highly reliable armoured vehicles with unmatched features. It is obvious that integrated warfare will dominate battle field thus all platforms will be communicating with each other at very high rates. Thus one of our focuses is the interoperability with various platforms, where again we work with

global OEMs for various payloads and platforms. Since we have already all digital infrastructure in our vehicles, this interoperability studies brings no big vehicle related development issues. For example, we have demonstrated a remote-controlled version of our vehicle in 2016, where we can remotely control not only the vehicle but also the payload, such as a robotic arm or remote weapon stations. We will continue in investing improvements in interoperability and high valued payload integration activities.

This interview was conducted by Korhan Özkilinc.

Spain's New Defence Champion

Esteban Villarejo

The Spanish government appointed Indra as the “national industrial coordinator” for the FCAS programme. The decision comes as a surprise for Airbus, which fears this decision will undermine decades of its growth and investment in Spain.

The acting Spanish Government has appointed the technology company Indra as the “national industrial coordinator” for the European FCAS (Future Combat Air System) defence programme, the largest joint European defence programme to date and the most ambitious in terms of technological development.

Eyebrow-Raising at Airbus

However, the decision caused a controversy as it relegates Airbus to the background; 4,16% of Airbus are owned by SEPI. The President of Airbus Spain, Alberto Gutiérrez, sent a letter to all employees of the company, saying that the “surprising de-

ger airlines, Airbus employs about 12.600 people in the factories of Getafe (Madrid) and Seville.

On the other hand, the State Secretary for Defense, Ángel Olivares, said that the “Future Combat Air System is a fundamental European cooperation programme to guarantee the future capabilities of our Armed Forces and our aeronautical industry. It must be considered a state project.”

In view of Airbus' harsh words regarding the current government's decision to nominate Indra, Olivares stated that “this selection will not hurt Airbus Spain”. “The Government guarantees to Airbus that it will receive the same workshare and of the same quality as if it had been the one designated as national industrial coordinator. Airbus and Indra do not compete with each other. Their areas of influence are different, so in no way Indra's election is detrimental to Airbus”, the senior official of the MoD said.

Olivares detailed that “Indra will not individually decide how the workshare is distributed in Spain. It will be approved by the Government of Spain through the approval of the Technological and Industrial Plan prepared by the MoD in collaboration with the Ministry of Industry, the Ministry of Science and Research and the Ministry of Finance through the SEPI.”

Photo: INDRA



Headquarters of Indra in Madrid

Indra, of which 18,71% are controlled by the Spanish State Company of Industrial Participations (SEPI), will perform this work together with industrial leaders designated by France and Germany (Dassault Aviation and Airbus respectively). “Its selection constitutes recognition of its defence systems capabilities, its experience in international programmes and its suitability for coordinating and acting as a driving force of Spanish industry”, Indra stated in a press release. “For Indra, its designation as the national coordinator represents a significant boost, as it enhances its credibility and increases its competitive capacity and its access to major international programmes.”

cision” could affect future investments of Airbus in Spain. “Airbus' decades of growth and investment in Spanish industry, technology and supply chain will be undermined by this decision”, the company explains.

From a European multinational aerospace point of view, “only Airbus has the scale, capabilities and experience to better represent the industrial interests of Spain and work on equal terms with the French and German national coordinators, and this decision can affect the industrial influence and Spain's participation in the largest aerospace and defence programme in the history of Europe”, Gutiérrez stated. Together with its aircraft production lines for passen-

The Spanish Champion of Defence

It should be remembered that Spain formally joined the FCAS project on 17 June 2019 when the defence ministers of France, Germany and Spain signed the Memorandum of Understanding at the “Paris Air Show”, with French president Emmanuel Macron as master of ceremony.

Indra's surprising choice is interpreted as the Spanish government's desire to build a so-called “Spanish defence champion”: a national company that can compete in the EU with French giants like Thales or Safran and German companies like Rheinmetall or MTU in future projects and in other markets.



Photo: AIRBUS DS

Final assembly line of the EUROFIGHTER at Airbus Spain in Getafe near Madrid

Since June 2019, Indra has been trying to negotiate the takeover of the engine manufacturer ITP Aero, which is part of Rolls-Royce. But in July, the British engine manufacturer stated that the talks "had ended without an agreement between the parties".

Indra is the only Spanish company among the top 100 defence companies in the world. The company is currently a member of nine consortia of the European Defence Industrial Development Programme

(EDIDP) and acts as coordinator of three of the five consortia led by Spain, of which the PESCO Strategic Leadership Programme is probably the most important programme involving Italy, Germany, France, Luxembourg and Portugal.

Indra's technological products (radar, electronic defence, command and control systems, mission systems, etc.) are widely recognised in the defence industry, as is its ability to implement

complex projects around the world. Indra also participates in international programmes, including European programmes such as Eurofighter, A400M, NH90, Meteor and ESSOR, as well as non-European and NATO-related programmes such as ESSM, FLEPS, ACCS and many others. Indra employs around 28,000 people in Spain.

Investment of €110M Approved

Regarding the FCAS programme, on 30 August 2019 the Spanish Council of Ministers authorised a budget of €110M to be spent over the next four years: €10M (2019), €60M (2020), €20M (2021) and €20M (2022).

The objective of this budget is to participate in the initial phase of the Technological Demonstration Phase (phase 1A). "Spain's participation in this first phase is considered essential to ensure that national operational requirements are taken into account in FCAS and to enable the involvement of national companies in the project," Spanish MoD staff told ESD.



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“One Mask, All Missions”

Photos: Avon Protection



Interview with James Wilcox, President Military, Avon Protection

ESD: “One Mask – All Missions” is your message to your customers. What does this mean?

Wilcox: The M53A1 can function as a conventional negative pressure mask or as a positive pressure mask, providing specialist operators with the ability to adapt the mask to meet the threat in seconds. Offering the user maximum mission flexibility with one system, the M53A1 can be combined with PAPRs (Powered Air Purifying Respirator), SCBAs (Self Contained Breathing Apparatus), combination PAPR/SCBA systems and even closed circuit systems to deliver adaptable protection factor through positive pressure, powered air and negative pressure modes with one single mask.

ESD: Does your M53A1 solution primarily or even exclusively address the military or might it attract attention of civilian first responders as well?

Wilcox: The M53A1 was developed from Avon Protection’s world class 50 series range so it has been specifically developed for the unique requirements of Special Missions units. The 50 series has multiple masks within the range, each of the masks offering different benefits to user groups depending on the threat, and their operational requirements. The M53A1, over the past 13 years since the first military delivery, has also become the mask of choice for first responders including tactical police officers and CBRN units due to its operational flexibility!

ESD: Can you elaborate on the US order you got?

Wilcox: In March 2019 we announced Avon Protection had been awarded a sole source contract to supply the US Department of Defence with M53A1 Protective Masks, ST54 SCBAs, PAPRs and related accessories. This framework contract (5 year IDIQ with 2 options years), which also covers additional Avon Protection products, including the MP-PAPR and recently launched ST54 SCBA has a maximum contract value of \$246M. Just a month after announcing the original contract win, we received our first order against the contract worth \$20.2M.

ESD: What other markets beyond the US do you currently focus on?

Wilcox: We have been supplying specialist solutions to military forces, civil and first line defence troops, emergency services for over 130 years. Our products are used in over 65 countries worldwide and these users all put their trust in Avon Protection’s technology to shield them from whatever threat whether air, land or sea based.

ESD: Does your customer service include training programmes to get familiar with the broad range of capabilities the M53A1 provides?

Wilcox: Our product line does include training post purchase for Level 1 (Operator) and Level 2 (Organisational Maintenance). Additionally we provide training/presentations to our sales teams and potential customers during the sales process.

**The interview was conducted by
Peter Bossdorf.**

ESD: What kind of CBRN threats do troops in operation nowadays have to be aware of?

Wilcox: The last decade has clearly demonstrated that the nature of threats to international security has changed significantly. Challenges such as terrorism, state and non-state sponsored attacks and perhaps more recently nuclear proliferation, have created an entirely new security environment. The threat is always evolving. At Avon Protection we are continuously working with our customers worldwide to ensure we design, develop and deliver world leading solutions to protect them from every possible threat whether air, land or sea based.

ESD: What are the key features of Avon Protection’s M53A1 solution?

Wilcox: The M53A1 mask and powered air system was specifically developed for Special Operations Forces and CBRN special mission units to counter the unique and domestic threats encountered on the modern battlefield, global war on terrorism and CBRN operations around the world. The M53A1 is the first dual use respirator for both military tactical operations and domestic response certified to MIL-SPEC and NIOSH CBRN approval. The M53A1 allows users to operate more effectively in a CBRN environment with improved comfort, improved vision, communications, weapon sighting and the ability to transition from negative pressure mask to a positive pressure in one simple action; ONE MASK ALL MISSIONS.

The M53A1 provides protection against traditional chemical and biological agents, specific toxic industrial chemicals and particulate matter, including radioactive dust.



Developments in the European Mortar Industry

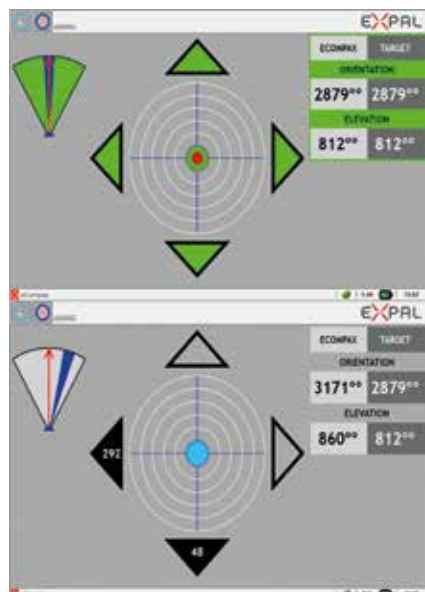
Waldemar Geiger

In view of the war in Ukraine and the associated reorientation of many armed forces towards national and alliance defence, the weapon systems required for this purpose, such as mortars, automatically become the object of modernisation efforts by the armed forces.

As expected, the efforts initiated and planned to modernise mortar systems in the armed forces have driven some technological developments in European industry, some of which were recently presented at the DSEI international defence exhibition in London.

EXPAL

EXPAL, a Spanish one stop shop for mortar systems, introduced eCompax, an electronic aiming device for dismounted mortar systems of all calibres. The eCompax weighs approx. 1.2 kg and measures 175x75x65 mm.



The eCompax software provides all necessary functions to align the mortar, either in standalone mode (on its own smart device) or integrated with a fire control computer. The numbers in the arrows of the graphic display (picture below) indicate in which direction and by how many mils the weapon system has to be directed.

Designed to replace conventional sight units, eCompax simplifies and accelerates the setup and aiming of dismounted mortars. The system has several GPS-independent sensors, including a camera, an inertial measurement unit (IMU) and a magnetic compass, which provide north finding and, consequently, data on the vertical and horizontal alignment regarding to all types of norths (magnetic, true and grid) of the mortar. According to the company, the mortar can be aligned with the target within 30 seconds.

At DSEI, EXPAL demonstrated that the system is very easy to operate. After reaching the firing position, eCompax is placed with the camera forward in the rough firing direction a few metres away in front of the mortar. The integrated north finder is to determine the magnetic north direction within approx. ten seconds to an accuracy of up to seven mils. The camera then shoots a series of images to optically "fix" the magnetically determined north direction. The images then serve as a guideline for the determination of the position of the weapon system, following which eCompax will be attached to the periscope mount on the bipod. Pictures are also taken here. An algorithm calculates the lateral alignment of the weapon system on the basis of the image comparison; the IMU determines the elevation.

In addition, the company presented M-Counter, an electronic shot counter for mortars. M-Counter works independently of energy sources and is to relieve mortar troops of documentation tasks and simplify maintenance planning through automatic data acquisition.

Hirtenberger

Hirtenberger Defence Europe exhibited the 120mm Super Rapid Advanced Mortar System MKII (SRAMS MKII) at DSEI. At Eurosatory 2018, Hirtenberger had announced a cooperation with ST Engineering under which Hirtenberger

would market the automatic mortars of the SRAMS family in Europe. In mid-November, the new system will be presented to a European expert audience in Slovakia for the first time. The original 120mm SRAMS had a hydraulic elevation and traverse, while the new SRAMS Mk II features a fully electric vertical and lateral adjustment, the latter being increased to 180 degrees on both sides.



The SRAMS MK I system (left) was equipped with a hydraulic elevation and traverse, the new SRAMS MK II (right) has a fully electric elevation and traverse.

There was also some news on the business side of Hirtenberger. The company received an order in the first half of 2019 to supply insensitive 60mm mortar ammunition to the Dutch armed forces. The framework agreement has a term of five years with the option of extending it by a further two years.

Rheinmetall

At the German Infantry Day in Hammelburg in July 2019, Rheinmetall presented the RSG60 60mm mortar for the first time. The innovative design of the weapon system saves space and enables users to prepare the mortar for fire in just a

few seconds from the transport position. By loosening the retaining bolts, it is possible to separate the RSG60 from the base plate in around thirty seconds, transforming it into a light-weight commando mortar.

The current version of the RSG60 could be seen at DSEI; it differs from the pictures released earlier which showed a demonstrator. In the current version, the handle and the base plate have been designed more ergonomically. In addition, a simple aiming device based on a compass and known as a "Quickshot aiming device" was displayed.

At DSEI, Rheinmetall unveiled the RAGNAROK (MWS120) automated 120mm mortar weapon system for the first time. The manually loaded and fully electric system with mechanical transmission enables a firing rate of 16-20 rounds per minute. With a weight of just under one tonne and, according to the company's figures, a significantly lower recoil than comparable competitive systems, RAGNAROK can also be integrated with light 4x4 platforms with the use of support legs without unduly impairing the vehicle's chassis structure. According to the product manager, the

for the purchase and training of a new system can be saved by continuing to use existing systems. In addition, it basically offers customers the opportunity to configure their own mortar. Depending on requirements and available budget, all individual systems can be combined by a single supplier or by different suppliers to form a complete mortar system (fully automatic weapon system with fire control system). A further advantage is that the components of the mortar can be individually modernised without having to redevelop the entire system. The introduction of new technologies and

Photos: Waldemar Geiger



At 15.6 kg, the RSG60 is a true lightweight. In the command mortar version, the weight is 6.8 kg.

The RSG60 development team said that the heat management of the mortar is not significantly affected by the composite construction of the new tube. Physically, lighter tubes heat up faster but cool down faster than regular tubes. The RSG60 tube has another handy feature. The thread at the end of the tube can be used to attach a tube extension. This can result in range advantages. In addition to the tube extension, Rheinmetall has also developed a prototype silencer that can be screwed onto the thread. The silencer's performance is just under 10 dB, which corresponds to a reduction in volume of almost 50%.

development of the RAGNAROK was aimed at the highest possible fire rate and modularity at the lowest possible price. For this reason, they decided against an autoloader and designed the system so that almost any 120mm tube used could be reused inside the RAGNAROK. The tube can be removed by the mortar crew and, if necessary, used with a base plate and a bipod as a regular dismantled mortar. In addition, the MWS120 is optionally available without an independent fire control system to enable further use of existing systems. The modularity of the RAGNAROK offers several advantages. If necessary, costs



Modularity, maximum possible fire rate and cost efficiency were decisive factors for the design of the RAGNAROK system.

products can thus take place much more quickly and easily during the operating phase.

Conclusion

The comparably simple and robust functionality of the mortar allows it to be used in all types of military applications. The mortar is and remains an important tool for military commanders in combat, especially when the mortar systems introduced by the armed forces are upgraded to the state of the art. ■

“The opportunity presented by the Japanese market is enormous.”



Photos: Clarion

Interview with Alex Soar, International Development Director, DSEI Japan, Clarion Events

the Japanese MoD is of course extremely useful, and we will look to deliver a JSDF audience that will not be present at other defence industry shows in the region.

ESD: What can attendees expect from the event?

Soar: A great gathering of both Japanese and international defence industry from across the entire supply chain. Alongside top flight educational content, showcases of current use equipment, international pavilions and representatives from the world's leading defence and security companies.

ESD: How is the event coming together at this stage?

Soar: Very well. The exhibition is nearly full. With over a dozen countries represented, about 200 companies exhibiting and 75 VIP delegations invited, we expect the show to be extremely busy. The conference committee has been carefully selected from Japan's leading military, academic and research organisations, and more than 20 speakers are confirmed to discuss a range of topics, including regional capabilities, requirements, and solutions, based around core themes over the three days.

ESD: How will DSEI Japan round out Clarion's events portfolio?

Soar: We intend for DSEI Japan to, as it matures, act as a counterpoint to DSEI in the UK. Set in alternate years, each can act as a lynchpin for the regional defence industry, much as DSEI already does in London. In a wider context, Clarion Defence & Security is clearly interested in the myriad opportunities available to a company such as ourselves in the wider Asian Pacific markets. This will certainly be an area of focus for the company moving forward. This has already started to bear fruit with the launch of VIDSE, the first tri-service and security event to be held in Vietnam, which will run in March of 2020.

ESD: What are some of the key technologies / market opportunities / growth areas in the Japan market at present?

Soar: I think this is a two-part answer; Firstly, Japanese companies are extremely keen to develop technology exchange partnerships with the global defence industry and are also rightly keen to develop export models of new or existing equipment to explore new markets with.

And secondly, from a purchasing perspective, the Japanese Government has announced a comprehensive programme of improvement and acquisition, including the expanded purchasing of F-35B as well as PEGASUS tankers.

The upgrades that have been announced to the IZUMO class helicopter carriers, to allow operation of F-35B represent a not insignificant amount of investment. As does the continuing purchase of Raytheon's ballistic missile interceptors, and a sizable investment into armoured vehicles for the JGSDF in the form of Type 16 MCVs and Type 19 SPGs.

So this represents a very real commitment to increasing the combat capability of the JSDF and ensuring that they are fit to handle the rapidly evolving threat spectrum in the region.

ESD: What are your goals for DSEI Japan event beyond 2019?

Soar: In the first instance we want to ensure that DSEI Japan meets the needs and requirements of not only the Japanese MoD, but also our visiting delegations and our exhibitors and partners. Looking ahead, we want to see the exhibition develop into the meeting place for all of Japan's allies in the region, and act as the focal point for the defence industry in the Asia Pacific region.

The interview was conducted by Peter Bossdorf

ESD: Why has Clarion elected to take the DSEI event to Japan in 2019?

Soar: DSEI is celebrating its 20th anniversary this year, so it seems only fitting to celebrate that by launching the first ever DSEI outside of the UK.

We have been working towards DSEI Japan for some 4 years alongside our partners Crisis Intelligence who run the Japanese national pavilion at DSEI in London.

With the reinterpretation of the Japanese constitution several years ago and the relaxation of restrictions on defence imports and exports, it is an appropriate time to offer a new route to market for those focused on the Asia Pacific region.

Combined with Japan's very real desire to improve their military capability in the face of regional frictions, the opportunity presented by the Japanese market is enormous for both Japanese and international industry.

ESD: What will DSEI Japan bring to the table that is not already on offer from other defence and security events in Asia?

Soar: Quite apart from the extremely high level conference that our Committee has put together for our delegates, it is extremely rare to see this number of Japanese defence companies in the same place at the same time. Certainly not in company with so many international prime contractors and exciting and innovative SMEs.

I feel that DSEI Japan will offer a unique perspective on not only Japan's indigenous defence market, but also on how that market wishes to interact with the wider global defence market. Offering up opportunities for collaboration and having the support of



Telecommunications on SYRACUSE Satellites

(ck) Airbus and Telespazio (Leonardo/Thales) have established a partnership to market military telecommunications services using the SYRACUSE IV satellites. SYRACUSE IV is a telecommunication system comprising two military satellites plus ground stations which enhance communication capabilities between and within operational areas and mainland France. The two 3.5-tonne satellites are being built by Thales Alenia Space and Airbus, with the launch planned for 2022. This partnership between Airbus and Telespazio will create France's leading private operator of military satellite telecommunications; it demonstrates the desire for cooperation by European industrial prime contractors Airbus, Thales and Leonardo, as well as the French State, in marketing SYRACUSE IV satellite capacity for the benefit of armed and security forces in Europe and around the world. The French Defence Procurement Agency (DGA), Airbus, Thales Alenia Space and Telespazio have put together a financing initiative, enabling any excess satellite capacity to be sold to third-party customers, thereby

Photo: Airbus



bringing down the total cost of ownership of the SYRACUSE IV system. These sales contracts, scheduled for a 10-year period, will enable allied countries or organisations to be offered flexible access to a strategic resource. Services will be accessible over a broad area ranging from French Guiana to the Straits of Malacca and will be deployed for maritime, terrestrial and air uses. Allied forces will thus have access to communication capacity in X-band, military Ka-band and X/Ka dual-band mode and benefit from the highest levels of protection and hardening provided for in the NATO standards. Units deployed in the field will be able to exchange video, voice and data via all-IP (Internet Protocol) communications at rates of up to several hundred Mbit/s.

Pallets for Aircraft and Helicopters

(ck) Multifunctional pallets for MEDEVAC and air transport are important in enabling military and civilian users of aircraft

Photo: AUTOFLUG



and helicopters to respond quickly to different requirements, ranging from the transport of passengers and those with slight injuries to the transport of intensive care patients who require continuous medical care throughout the flight. The differing needs are facilitated by simple superstructures and conversions on the pallets with the standard dimensions HCU-6. In order to develop new multifunctional pallets, AUTOFLUG organised a conference with high-ranking representatives from industry, the military and civil organisations to exchange ideas between manufacturers and users of pallet solutions. In addition to significantly expanding the current capabilities of military transport aircraft, the programme will focus on humanitarian aid applications.

Small Boat Support Contract for Babcock

(ck) The UK MoD has contracted Babcock to provide repair and maintenance services to small boats used by the Royal Navy, Royal Marines and the MoD Police. The contract has a duration of six and a half years. Babcock is one of a number of companies appointed to provide in-service support for planned and reactive maintenance to the small boat fleet, including ARCHER class patrol and training vessels,

Photo: Babcock



Rigid-Inflatable Boats, yachts, static training vessels, small cadet boats and police boats. Work will take place across naval bases such as Devonport and Portsmouth, training establishments and UK overseas territories (Gibraltar, Cyprus, Brunei and the Falkland Islands). The work will include transportation, spares, trials, post design services (PDS) and reliability monitoring.

Babcock Preferred Bidder for UK Frigate Programme

(ck) The UK MoD has selected Babcock Team 31 as the preferred bidder to deliver its new warships. Led by Babcock and in partnership with the Thales Group, the T31 general purpose frigate programme will provide the UK Government with a fleet of five ships, at an average production cost of £250M per ship. Following a competitive process, ARROWHEAD 140, an adaptable and technology-enabled frigate will be the UK Royal Navy's newest class of warships, with the first ship scheduled for launch in

Graphic: Babcock



2023. At its height the programme will maximise a workforce of around 1,250 in multiple locations throughout the UK, with an additional 1,250 jobs in the wider UK supply chain. Work on the fleet of five ships will begin immediately following formal contract award later this year, with detailed design work to start now and manufacture commencing in 2021 and concluding in 2027.

3D Printing Certificate for thyssenkrupp

(ck) Additive manufacturing (AM), also known as 3D printing, will have a significant impact on the future value chain. Industry is looking to take advantage of additive manufacturing to print spare parts, thereby reducing lead times, costs, stock requirements, and environmental impact. It is important that AM components are of the same quality as conventionally manufactured parts and in August 2019 the technical classification and assurance organisation DNV GL awarded its first Approval of Manufacturer certificate to thyssenkrupp Tech Center Additive Manufacturing; thyssenkrupp had demonstrated its ability to reliably produce metallic materials

Photo: DNV GL



using AM. The certificate ensures that AM part users can have the same confidence in an additive manufactured product as a conventionally produced one. The certificate makes the thyssenkrupp Tech Center Additive Manufacturing the world's first producer of 3D-printed parts to obtain manufacturer approval from DNV GL. Accordingly thyssenkrupp Tech Center Additive Manufacturing is an DNV GL approved supplier. tkMS is working closely with international customers on the integration of 3D-printed parts on ships and submarines.

EW Suite for Portuguese KC-390 Aircraft

(ck) The Portuguese MoD has selected Elbit Systems to supply a complete Electronic Warfare (EW) suite for the Portuguese Air Forces' new KC-390 multi-mission aircraft. Finalisation of the contract is subject to completion of the Portuguese Government's approval process. The EW suite for the KC-390 aircraft will comprise Radar and Laser Warning Systems, IR Missile Warning System, Countermeasures Dispensing System as well as the Directional



Photo: Elbit

IR Countermeasures (DIRCM) system and Active ECM (AECM) system. The EW suite will provide the platforms with advanced protection to achieve the customer's operational requirements.

Study on TYPHOON's EW System

(ck) BAE Systems has contracted Leonardo to explore the future of the Eurofighter TYPHOON's PRAETORIAN Defensive Aids Sub System (DASS). The EuroDASS consortium, which comprises Leonardo, Elettronica, Indra and Hensoldt, will spend 18 months exploring future upgrades for the Eurofighter TYPHOON's electronic warfare system. The 'PRAETORIAN Long Term Evolution (LTE)' study will investigate new technologies to keep the Eurofighter TYPHOON as a survivable and effective combat aircraft against a background of accelerating technology development by potential adversaries. The contract is a key part of the wider Eurofighter TYPHOON LTE study, which aims to identify a suite of technology enhancements for the Eurofighter TYPHOON's weapons system infrastructure and propul-

sion to provide a road map for the future of the platform. The PRAETORIAN DASS equips the TYPHOON with advanced protection from threats including Infra-Red (IR or heat-seeking) and radar-guided missiles. The system is well-regarded by users and has been battle-tested in Libya and Syria.

Communication System for MQ-25 UAS

(ck) The US Navy has awarded Frequentis a contract to provide the IP-based voice communications system for the Unmanned Carrier Aviation Mission Control System (UMCS) MD-5 control station, in



Photo: Frequentis

support of the MQ-25 programme. The MQ-25A STINGRAY will be the first operational carrier-based unmanned aircraft and will provide an aerial refuelling capability to the carrier air wing (CVW), extending global reach and operational capabilities. UMCS is the system-of-systems required to control the MQ-25A air vehicle. The UMCS programme manages all infrastructure modifications required on shore and aboard carriers as well as integration with existing network, command and control communications systems. Frequentis will provide engineering and logistics for the design, development, testing, manufacture and sustainment of the integrated communications system. Work will be performed in Columbia, Maryland, and is expected to be completed in March 2021.

Communication Equipment for Sweden's Police

(ck) The Swedish police have announced that they intend to sign two framework agreements to procure communication equipment from INVISIO; the announcements are not to be regarded as signed agreements. The framework agreements will include communication equipment with active hearing protection and be valid for two years with the possibility of an extension for a further two years.

MISTRAL and ASRAAM Missiles for India

(ck) MBDA, Europe's leading missile manufacturer, has signed an agreement with Bharat Dynamics Limited (BDL) of India



Photo: MBDA

for the final assembly, integration and test (FAIT) of MISTRAL and ASRAAM missiles in India. The Memorandum of Understanding (MoU) was signed on 12 September at DSEI in London. BDL is a major Indian weapon systems integrator and has supplied more than 130,000 weapon systems to domestic and foreign customers. MBDA has a long history of working with BDL, which has already seen over 50,000 MBDA-designed missiles manufactured in India. ASRAAM is India's New Generation Close Combat Missile. With its large rocket motor and clean aerodynamic design, ASRAAM has very high speed, aerodynamic maneuverability and range. The IAF's JAGUAR aircraft are the first Indian platform to receive this air-combat missile. MISTRAL, with its success rate of over 96%, during all firings, has been selected by many forces around the world and has been offered to the Indian armed forces to meet their VSHORAD requirement.

Virtual Targeting Simulators for US Army

(ck) Meggitt Training Systems, a supplier of integrated live-fire and virtual weapons training products and services for armed forces and law enforcement, has received additional orders that form part of a vital US Army combat skills training programme for American and allied warfighters. The US\$15.8M in orders, awarded by Tank-automotive & Armaments Command since May, and being installed in the coming four months, are part of the Army Targetry Systems III indefinite delivery/indefinite quantity, five-year contract. Meggitt's offerings include a variety of multi-function and stationary infantry targets, as well as moving infantry and armour targets, to provide maximum realism during training. For example, Meggitt Training Systems' Moving Infantry Target travels at three speeds to replicate an individual walking (4-6 kph), jogging (8-10 kph), and running (12-14 kph) on flat terrain. All standard target commands – such as expose, conceal, hit fall, hit hold, hit bob, and selectable number of hits to kill – are performed by the MIT. The target actuator is equipped with an accurate sensor that detects, responds to and reports hits. The elevated two-rail track

system – available in 50-foot, 80-foot, and 100-foot lengths – is easily assembled with hand tools. Meggitt Training Systems' infantry field range targets perform in the harshest climates and do not contain hydraulic fluids, contaminants or hazardous toxins capable of being released into the environment.

Chemical-Resistant Coatings for US Army Trucks

(ck) Mack Defense and Sherwin-Williams General Industrial Coatings have partnered to apply Chemical Agent Resistant Coatings (CARC) on the Mack Defense M917A3 heavy dump truck (HDT) model. Sherwin-Williams is a supplier of military grade coatings which are designed to meet the requirements of the US DoD. The CARC coatings for the HDT are designed to protect the vehicle from corrosion, wartime chemical and biological weapons, provide specific camouflage properties for added protection for the operator and extend the vehicle's life cycle. The M917A3 programme is currently on track and in accordance with all US Army requirements. All HDT trucks must have been delivered to the military by May 2025.

Rohde & Schwarz Establishes Joint Venture

(ck) Rohde & Schwarz and MESIT have established a joint venture (JV) to further develop the SOVERON product portfolio for secure armed forces communications. SOVERON stands for integrated and scalable communications solutions for the



Photo: Rohde & Schwarz

armed forces. The JV is named DICOM and has commercial operations in Uherské Hradiště in the Czech Republic. DICOM will be a research & development (R&D) undertaking; it will focus on the SOVERON lightweight handheld software-defined radio (SDR) with networking and multiband capability in the UHF/VHF frequency range.

RAFAEL to Enter UAS Market

(ck) RAFAEL Advanced Defense Systems has acquired Aeronautics Ltd, an Israel-based developer of unmanned aerial sys-



Photo: Rafael

tems. Aeronautics provides solutions based on unmanned systems platforms, payloads and communications for defence and civil applications. The acquisition is part of RAFAEL's growth strategy and Aeronautics will take part in some of RAFAEL's projects. The vision is to increase mutual growth, explore new markets, and provide end-to-end solutions in the low-tier aerial domain, relying on best practices, mutual expertise and capabilities, thereby creating new synergies and solutions.

RAFAEL Joint Venture in India

(ck) Astra Rafael Communication System (ARC), a joint venture between Astra Microwave Pvt Ltd (AMPL) and RAFAEL Advanced Defense Systems of Israel, has



Photo: Rafael

opened a new production facility at Hardware Technology Park, Hyderabad. The joint venture is in line with the Government's "Make in India" initiative and will invest in high-end technology and advanced production techniques to design, develop and manufacture state-of-the-art Tactical Communication systems (BNET) for the Indian Armed Forces. The joint venture's focus is on leveraging the technological ability and indigenous manufacturing capability of AMPL to support the requirements of the Indian Armed Forces in the "Make in India" programme. ARC will soon be India's first private sector company to manufacture sophisticated Software Defined Radios at its Hyderabad facility. The focus is on supporting Indian defence requirements and exports to the global market.

RUAG Completes Inspection on Dornier 228

(ck) RUAG MRO International has completed the annual inspection of three Italian Army Dornier 228 aircraft with special mission configurations. The inspections were

carried out at the RUAG facility in Oberpfaffenhofen, Germany. In addition to the maintenance check, the customer opted to upgrade the avionics for each aircraft to comply with the European Aviation Safety Agency (EASA) ADS-B Out/EHS mandates for 2020. Mini-tablet holders were also introduced to the cockpit environment. The inspections were completed on schedule and to full customer satisfaction. RUAG, the original equipment manufacturer (OEM) of the Dornier 228, planned the three heavy maintenance inspections to take place



Photo: Esercito Italiano

consecutively to ensure continuous aircraft availability. Each event was designed to optimise downtimes by including additional installations and avionics options. Prioritising compliance with upcoming EASA ADS-B Out/EHS mandates for 2020, the Italian Army planned the avionics modification to coincide with each Dornier 228's annual inspection and they also chose to combine the events with a retrofit of the VHF radios to 8.33 kHz spacing.

Protection for 3D Printing Blueprints

(ck) The US Air Force has chosen SIMBA Chain to help with Additive Manufacturing efforts. The Air Force uses a complex supply chain to equip and repair forward-deployed forces and SIMBA Chain will play a key role in securing that chain. Long value chains are among the biggest security issues in manufacturing for Industry 4.0. This is the case for all manufacturing but is especially critical in military applications, where hostile entities would attempt to obtain or modify critical data. To coordinate distributed manufacturing in the field, the Blockchain Approach for Supply Chain Additive Manufacturing Parts (BASECAMP) project will use the SIMBA Chain platform to create a prototype demonstrating a blockchain approach for the registration and tracking of Additive Manufacturing (AM) components during their entire lifecycle. With SIMBA, the Air Force's BASECAMP project aims to decentralise Additive Manufacturing in the field while maintaining the integrity of data. This means that repairs to vehicles can't be tampered with by a third party, as top-secret

3D printing plans could be transmitted to forward forces without unwanted surveillance. Blockchain is an ideal application for its decentralised nature, and SIMBA provides a simplification layer for blockchain developers to implement complex, security-focused solutions like BASECAMP.

ST Engineering Acquires Satcom Anti-Jamming Capabilities

(ck) As more satellites are launched in the coming years to meet the exponentially growing demand for connectivity in smart cities, there will be a significant increase in demand for anti-jam capabilities. Radio frequency interference in satellite communications (satcom) is a growing concern for military and commercial users alike. The US-based company Glowlink Communications Technology designs solutions that mitigate satellite interferences and improve the quality of satcom. Glowlink's patented Communication Signal Interference Removal (CSIR) algorithm provides real-time isolation and removal of satellite interferences. It delivers an effective and robust solution that does not require additional bandwidth compared to existing technologies, and which helps customers save costs while overcoming interference threats. Its satellite network management solutions are able to detect and remove satellite signal interferences in an increasingly dense satellite space. ST Engineering has now acquired Glowlink for US\$20M. Glowlink's products span carrier and spectrum monitoring, interference detection and mitigation, geolocation, and satellite capacity planning which will augment ST Engineering's bandwidth-efficient, scalable and secure satellite solutions.

Runflat Tyres for Armoured Vehicles

(ck) During a recent series of demonstrations by DCD Protected Mobility of South Africa, the company fitted Tyron All Terrain Rubber Runflats, the ATR-MP, to its SPRINGBUCK Armoured Personnel Carrier to ensure that the vehicle could keep moving in the event of a sudden deflation. During the demonstrations, which focused on route clearance, the SPRINGBUCK set off a simulated IED before coming under attack from enemy forces. At all times the vehicle was able to keep moving, even though its tyres were no longer inflated, as the Ty-



Photo: Tyron

ron ATR Runflats ensured that the damaged tyres were still locked to the wheel and didn't spin independently. The runflat also ensured that the vehicle was still running on rubber which not only gave the vehicle traction but reduced the physical stress on the crew. The Tyron ATR wheel assembly has a multi-part rubber runflat fitted to two-part bolt-together steel wheels produced by the company Global Wheels. This system is locally manufactured for the SPRINGBUCK APC. The Tyron All Terrain Rubber Runflat also successfully passed ballistic tests. Emphasis was placed on the connections to ensure that under severe

ballistic attack the ATR was not compromised, as rubber absorbs far more energy than hard materials from kerb strikes and IEDs. The bolt-together wheels are available in both steel and aluminium, the rubber of the ATR is enhanced to ensure beadlock, which offers a guaranteed high level off-road flat tyre performance which is not possible with composite runflats.

SubCon 2019

(ck) Since 1995, thyssenkrupp Marine Systems (tkMS) has been organising the SubCon conference in Kiel, Germany. The 2019 conference was themed "one family. worldwide. deep down", and it

saw, after the welcome address of tkms CEO Dr. Rolf Wirtz (Photo), 61 presentations held by experts from tkMS and its industrial partners. More than 350 domestic and foreign guests attended the event which was about submarine design, modernisation or maintenance, marine and propulsion technology, positioning and communication systems, stealth, new trends in armament, training and simulation - and, of course, artificial intelligence, cyber and digitisation. New developments presented were ORCCA and the fourth-generation fuel cell. ORCCA is a combat management system (CMS) for submarines integrating data from the various systems on board via a multifunction console. According to



Photo: tkms

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the company, the system can be used for all submarines from tkMS. The fourth generation fuel cell was designed as a modular system consisting of redundant components to ensure maximum performance at all times. For the storage of H₂, the system relies upon metal hydride cylinders without any active components. The hydrogen molecules are collected in the crystal lattice of the hydride. Since the system is supplied with hydrogen in its purest form, no chemical conversion is required, and the efficiency of the overall system remains high. Unlike other AIP systems (such as reformers, Stirling), which produce carbon dioxide using liquid fuel such as diesel oil, which has to be evacuated along with other possible by-products contained in the fuel, such as sulfur, water is the only by-product of tkMS' fuel cells.

UMS SKELDAR on a Growth Path

(ck) As part of its expansion strategy, UMS SKELDAR, a European provider of Rotary Unmanned Aerial Vehicles (UAV), is introducing training initiatives, with 2020 being identified as the year of change for its training delivery programme. With impending regulations towards the end



Photo: UMS SKELDAR

of this year and new rules of engagement coming in the next 12 months in the Unmanned Aerial Systems (UAS) industry, there is need for change in the way training is delivered. Along with the Group's new 450 square metre facility in Sweden, which will provide additional capacity for its software operations and research and development, UMS has bolstered its operations in Switzerland with regard to prototyping and product testing and modification. UMS SKELDAR is a joint venture between SAAB and UMS AERO GROUP.

New Owners of Revision

(sb) One of the world's leaders in protective eyewear for defence and security professionals, Revision, announced the sale of its business, including its facility in Essex, VT, and the Revision name and trademark, to two private equity firms: ASGARD Partners and Merit Capital Partners. Some 130 members of the Vermont-based Revision team will continue to run the Revision eyewear business, while former Revision CEO, Jonathan Blanshay, is preparing to launch a new company that will build on and sharpen the remaining portfolio with funded expansion of "capabilities and growth initiatives around enhanced warfighter survivability and lethality." Areas other than protective eyewear, in which Revision has been investing include active, integrated head-borne and body-worn systems, as well as power management and communications solutions. Since its founding in 2001, Revision has made significant impact in the protective eyewear arena, supplying top-class combat units including the US, German, British and Canadian armies. The company has managed perceptions and realities very well, and is well positioned globally in terms of current and future product lines, but in particular within the "Five Eyes" nations (UK, US, Canada, Australia, New Zealand), and throughout NATO.

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Announcement and Call for Papers
Brussels, 28/29 January 2020
16th NATO Life Cycle Management Conference

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**Innovation and Disruption in LCM -
Opportunities, Achievements and Lessons Learned**

Chaired by: Thomas E. Pedersen and J. Bo Leimand (ret), Danish Defence Acquisition and Logistics Organisation (DALO)

The annual NATO LCM Conference will continue to consider the lessons learned and achievements made in areas such as Quality Assurance, Life Cycle Costing, Configuration Management, Acquisition Practices, Material Maintainability et al. as a basis for new and innovative, even disruptive approaches and perspectives which will be introduced in respective presentations. The event will again be organised in cooperation with the NATO Life Cycle Management Group (AC/327) and with the support of the NATO Industrial Advisory Group (NIAG) and the German CALS Forum. The conference will be combined with a small exhibition, where interested parties are invited to showcase respective capabilities and will take place at the Parker Hotel Brussels Airport on **28/29 January 2020**.

Scope of the Conference

According to NATO's Systems Life Cycle Management (SLCM) policy the main goal of systems life cycle management is to efficiently and effectively deliver, use and maintain NATO capabilities. The primary objectives include:

- To have a common understanding of all aspects of SLCM;
- To create integrated and seamless business management practices, from initial concept to retirement;
- To establish effective collaboration between all stakeholders, with clearly defined responsibilities;
- To facilitate technology insertion, mid-life updates and address obsolescence based on life cycle considerations;
- To define and apply an integrated systems approach to the development, use and support of systems;
- To acquire systems that fulfil operational and logistic requirements, optimise internal and external interfaces, address integrated logistics and in-service support, and minimise production, in-service and disposal impacts on the environment.

Against this background, the 16th NATO LCM Conference will provide a platform for the presentation of innovative approaches and concepts in support of effective materiel management. In addition to specialist presentations and papers the conference will provide ample opportunity for the exchange of information between and among experts, programme managers and decision makers from the nations' armed forces, defence administration and industry.



Briefing Abstracts

The papers/briefings are to present status reports and results as well as expert analyses of current and future LCM, LCC and ILS implementation projects. Today, the military environment is increasingly influenced and characterised by cooperative models, innovative economical schemes and the need for environmentally friendly solutions. In response to that, presenters are encouraged to also consider related aspects of their subject.

- Those interested in giving one or more presentation(s) in accordance with the theme of the conference are requested to submit their abstract(s) preferably in an electronic format (email);
- The time slots for the presentations are limited to 20 - 30 min. incl. 5-10 min. discussion time;
- Abstracts should not exceed 10 - 15 lines and should briefly address the subject and objective of the presentation;
- Your abstract submission should include the title(s) of the presentation(s), name and position of the speaker, organisation and full address with phone and fax numbers and email address.
- Deadline for the submission of abstracts: **15 October 2019**,

following which information on the selected papers and further information will be circulated.

Points of Contact

Please send abstracts to the PoCs below. AC/327 will be pleased to advise you on the content of your paper, whereas Mittler Report Publishing is in charge of all organisational aspects.

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AC/327

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