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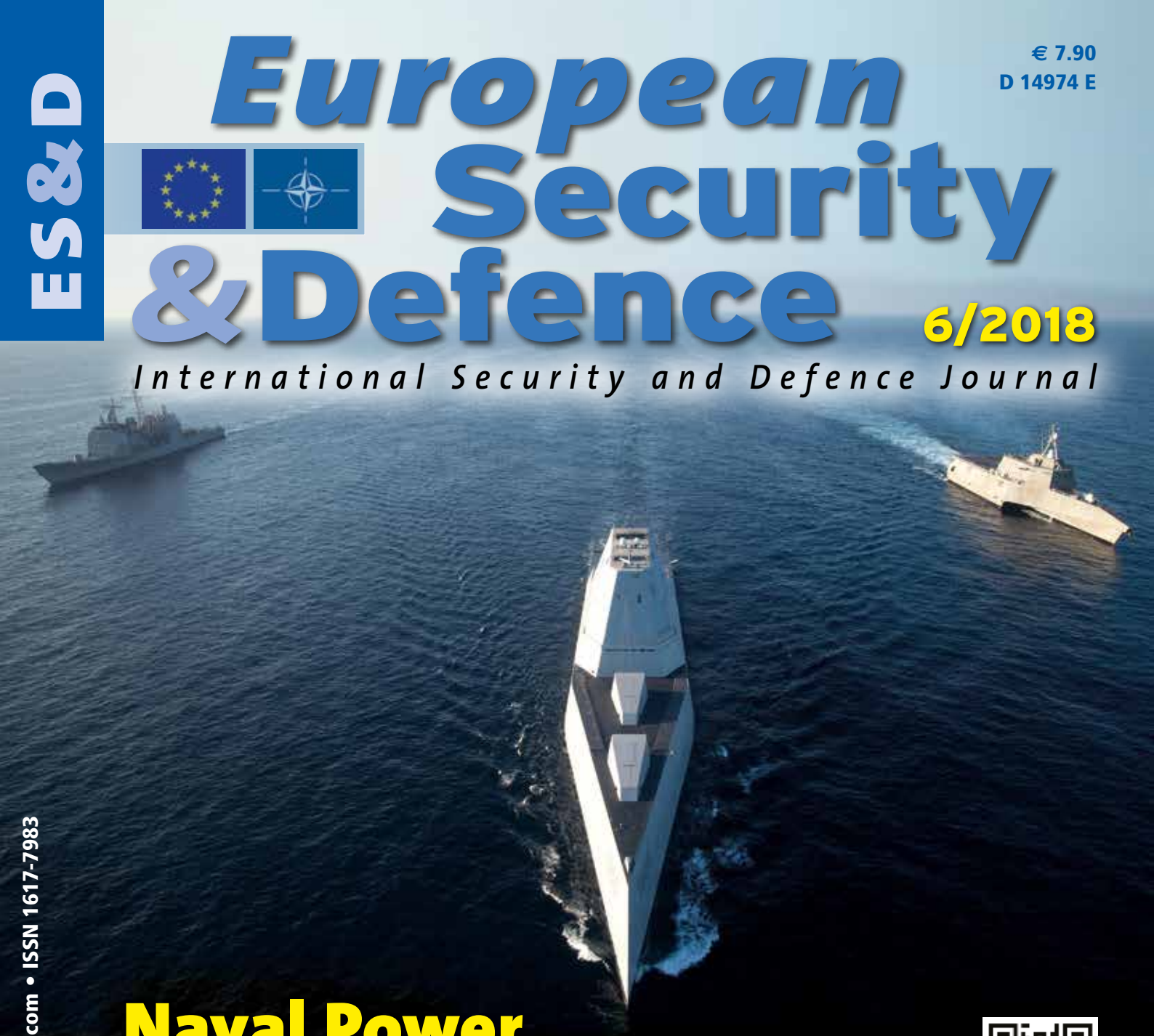

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The Wall Is Blancmange

In the last edition of ESD our opening editorial was an interesting assessment of the NATO Summit in Brussels, leading with the contention that President Trump had run into a brick wall, as the united NATO front presented by the European leaders was characterised, and that his "clumsily presented"
demand for all NATO nations to contribute two percent of GDP had the effect of an own goal – a "bloody nose" – and of pushing the European NATO nations more closely together…
I'm afraid not.
First, European perceptions that President Trump has no credibility at home are built upon fake news, a tendency to believe only like-minded commentators and wishful thinking. In the imminent mid-terms his party will probably lose a number of seats in Congress, but there has only been one single modern exception to that, and in the meantime European politicians and media lap up the news that best fits their own thinking, and aggressively denigrate any difference of opinion.
Mr. Trump has his problems with individuals in and around his cabinet, but Macron has Le Pen, Merkel has Seehofer, May has Johnson, the Spanish have Catalonia and the Italians have Berlusconi; so who doesn't? This time, though, when it comes to the masses, it appears that left-wing rioters are considerably more hostile, violent and extreme than their right-wing counterparts: which of them holds the higher moral ground? And just how bad will it be when the political pendulum swings back again?
Dealing with the two percent question, the most significant country to fail to meet that target is Germany. This is not through lack of money, but simply through a lack of political will: while the Chancellor led a sort of reversed Pied Piper of Hamlin, throwing open the doors to unbridled and uncontrolled mass immigration, the Bundeswehr – that resource ultimately available to ensure safety for the people – reported disastrous fractional major equipment operational availability: 26 out of 93 TORNADOs,
16 of 72 CH-53s, 12 of 62 TIGER attack helicopters, 3 of 15 A-400s and 0 out of 6 submarines, among others. But this is only part of the story: German willingness to see NATO as a national tool to which the country contributes vanishingly little in comparison to real sacrifices made by smaller and less robust economies gives it a suitable mattress upon which to cultivate the national angst for a bit of 21st century mea culpa. This is not good enough.
Germany enjoyed a fabulous, and well-deserved, economic resurrection from the middle of the last century that underpins its current prosperity, but abrogating its international obligations because "Oh, we did bad things" (cue wringing of hands) is a poor excuse. The other excuse is, as was recently explained to me, "If we paid 2% of our GDP we'd pay more than the rest of Europe"… Well, yes, that's the point of a percentage – and see operational availability, above. And of course, "Our people won't accept our troops being genuinely killed, so that's why we deploy to the safest places in theatre…" Really?
These are problems that come back to German politics and German politicians, and to their creation of a culture that uses the past as an excuse: idealism is all well and good, but let's have some pragmatism as well, and let's open our eyes, ears and minds to "another's" viewpoint.
Bear in mind: this is not a phenomenon that is confined to the world of security and defence: "Atomkraft Nein Danke" ("No to Nuclear Energy") has simply meant a price increase, with Germany buying nuclear-power-generated electricity from its neighbours, a huge leap into the unknown with North Sea wind farms, and the country entering into a strategically-suspect reliance on Russia for its gas supplies. Might President Trump actually be right?
There seem to be three lessons for "the West". The first two concern the populations of our two key nations. In the US it is time for people to understand that a working democracy requires compromise, mutual respect, and adhering to the rule of law; and the notion of exporting the broken US model of democracy to Egypt, Iraq and Syria, for example, is laughable. In Germany it is time for an end to the popular idea that we can all be apologists and idealists and to join the grown-ups in managing a Europe driven by facts, not federalism.
And finally, going back to the NATO wall of solidarity, quite apart from whether the West promised that there would be limited or no expansion towards Russia, the ability of a bloc of 9 nations to decide and act is significantly better than that of 16 nations, or indeed 29. To characterise NATO as a solid bulwark of military capability at the behest of a large body of like-minded commanders-in-chief is to ignore the realities of a fragmented Europe. Brexit was a symptom, and the sitting governments in Hungary, the Czech Republic and Poland are another: the situations of Ireland, Greece, Portugal and Spain are another. It is not possible for Europe to become like the USA, or like China – we have too many peoples, traditions, heritages, different ambitions and different languages. But the role of a government is, primarily, to provide safety and security for its citizens that can only be achieved with political willpower behind a robust, deployable deterrent; perhaps NATO has finally outgrown itself.

Stephen Barnard

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ARMAMENT & TECHNOLOGY

INDUSTRY & MARKETS

VIEWPOINT FROM ...

COLUMNS

Arnold Defense Starts FLETCHER Production

(sb) Arnold Defense, the St Louis-based manufacturer and supplier of 2.75-inch rocket launchers, announced the start low-rate initial production (LRIP) of the

Photo: Arnold Defense

FLETCHER land-based, 2.75-inch/70mm Weapon System. The FLETCHER system can be mounted on military vehicles as well as base defense platforms. In June 2018 the company revealed that a successful test firing had taken place, proving the concept of FLETCHER when used as a ground-based weapon system and demonstrating the capability to a range of interested specialist users from across the globe. A target hit rate of 100% was achieved at ranges between 2 km and 5 km. First deliveries of the LRIP run will take place to an undisclosed customer. Jim Hager, President and CEO of Arnold Defense said "The FLETCHER system entering production is a huge win for the team, following on from the launch of the concept at DSEi in 2017 and then the successful test-firing earlier this year". He added, "We look forward to seeing the successful deployment of FLETCHER providing the warfighter with a new fast, smart and lethal weapon system."Arnold Defense has manufactured more than 1.1 million 2.75-inch rocket launchers since 1961 for the US Army, Navy, Air Force and many NATO customers. They are among the world's largest suppliers of rocket launchers for military aircraft, vessels and vehicles. Core products include the 7-round M260 and 19-round M261 commonly used on helicopters; the thermal coated 7-round LAU-68 variants and LAU-61 Digital Rocket Launcher used by the US Navy and Marines; and the 7-round LAU-131 and SUU-25 flare dispenser used by the US Air Force and worldwide. Arnold Defense designs and manufactures various rocket launchers that can be customised for any capacity or form factor for platforms in the air, on the ground or at sea. Current Arnold Defense rocket launchers include the ultra-light LWL-12 that weighs just over 60 lbs. (27 kg.) empty and the new FLETCHER four-round launcher.

MSM Introduces New Long-Range 155mm Artillery Ammunition

(sb) Leading Slovakian defence company MSM GROUP Ltd., embraces numerous subsidiaries and manufactures various natures of ammunition, wheeled and tracked military vehicles, radio navigation devices and special containers as well as being involved in helicopter pilot training and information technology. In the 1920s, in the western Czechoslovakian town of Plzeň, the Škoda Works enjoyed a monopoly in the production of ammunition and the decision was taken to build a "backup" factory in the east. The company was totally destroyed during World War II. After many years of intensive rebuilding MSM Group not only produces ammunition for the Slovakian MOD, but for many countries worldwide. The company manufactures weapons as well as ammunition, including 60mm mortars (with ranges between 80m and 3,100m), the HORNET anti-tank weapon – a 9km range, fibre-optic guided weapon with an 8kg tandem warhead – assorted 155mm ammunition, and the ALIGATOR 4x4 MASTER light armoured vehicle using some widely proven western components such as Cummins motors and Allison gearboxes, and which is the basis for numerous variants. From the 155mm ammunition range MSM has recently introduced its latest development, the hybrid 155mm HE-RA/BB. This round delivers its warhead out to 56.2km maximum range. The mix of rocket assistance and base bleed aerodynamic management is not new, but the MSM round extends the range of most 39, 45 and 52 calibre 155mm gun howitzers by some 10km: in effect 39 calibre gun howitzers will offer the same range as 52 calibre systems with "traditional" ERFB-BB projectiles. It is not suggested that the 155mm HE-RA/BB ammunition should

Picture: MSM Group

replace existing HE artillery rounds, but it can complement existing ammunition/gun systems to give greater engagement ranges without special training or logistics. A typical 155mm HE-RA/BB engagement should see friendly assets being well beyond the range of conventional counter-battery assets, or alternatively permits greater penetration into rear-echelon areas: terminal effects (blast, fragmentation, penetration) are as for a standard round, with excellent results against structures. Manufactured by the ZVS subsidiary of MSM Group (founded in 1927) the 155 HE-RA/BB round offers outstanding range as well as top quality and reliability, and the company offers an intriguing cost-effectiveness proposal: Eastern Europe is very well known for both properties. Since 2009 MSM Group has enjoyed the benefit of investment by the Czech conglomerate CSG, the latter's part-ownership also providing access to an additional, equally highly qualified workforce and to a vast historical, technical documentation archive. The company itself has identified several export markets for the 155 HE-RA/BB round, including Africa, where its blend of quality and price will present a compelling and challenging option.

MAN Trucks for Australia

(ck) Under the LAND 121 Phase 5B programme, Rheinmetall MAN Military Vehicles Australia (RMMVA) will deliver more than 1000 highly mobile logistics vehicles

Photo: Rheinmetall

and more than 800 modules to the Australian Defence Force (ADF). Deliveries will start in 2019 to be completed in 2024. As part of the LAND 121 Phase 3B programme, RMMVA is currently supplying protected and unprotected military logistics vehicles and modules from its Brisbane integration facility. The vehicles will be tested on the 1000 hectare site of the Australian Automotive Research Centre near Anglesea, 125 km south-west of Melbourne.

Australia Orders BOXER

(ck) Australia has contracted Rheinmetall to deliver 211 BOXER wheeled armoured vehicles worth a total of €2.1Bn to the Australian Defence Forces (ADF). Delivery of the advanced 8x8 Combat Reconnaissance Vehicles (CRV) will take place between 2019 and 2026. The BOXER vehicle is already in service with, or being procured by, the armed forces of Germany, the Netherlands and Lithuania. The ADF will introduce several variants of the BOXER with the reconnaissance variant – accounting for 133 of the 211 vehicles – equipped with Rhein-

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Photo: Rheinmetall

metall's LANCE turret system and armed with a 30mm automatic cannon. According to the ADF, the BOXER was chosen in 2016 under Australia's LAND 400 Phase 2 selection process as one of two candidates for Risk Mitigation Activity trials where the 8x8 wheeled armoured vehicle performed convincingly in the categories of survivability, mobility, firepower, and command & control. A sizable share of the value added during production of the BOXER will take place in Australia; more than 40 Australian companies will be included in the programme.

First Automated Landing for a REAPER

(ck) On 7 August 2018, the USAF completed the first-ever automated landing of an MQ-9 Block 5 Remotely Piloted Aircraft (RPA), followed by the first auto-takeoff on 9 August. The new Automatic Takeoff and

Photo: USAF

Landing Capability (ATLC) was developed by General Atomics Aeronautical Systems, Inc. (GA-ASI) to enhance mission capability. The new, all-weather capability increases the autonomy, flexibility, and combat effectiveness of the MQ-9 REAPER. The auto launch and recovery during these critical phases of RPA flight also enlarges the operational envelope for cross wind operations. "Adding this level of automation will reduce the deployment burden on the warfighter and expand the scope of missions that can be flown by Air Force MQ-9s", said David R. Alexander, President, Aircraft Systems at GA-ASI.

Iveco TRAKKER for Germany

(ck) The 100th TRAKKER of a total order of some 133 tactical military trucks has been delivered by Iveco Defence Vehicles to the German Bundeswehr, the German Armed Forces, represented by the BAAINBw (Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support). MoD representatives and industrial partners attended the handover ceremony at the Iveco Defence Vehicles' site in Ulm, Germany. The 133 highly mobile protected military trucks are part of a contract signed in 2015 as part of the German Army GTF (Geschützte Transportfahrzeuge) procurement programme, with delivery over four years. The vehicles are equipped with a protected cab, which currently offers the highest lev-

Photo: IVECO

els of ballistic, mine and IED protection in five different configurations, including various types of ISO-container transport body work, some with hydraulic cranes and winch systems. Over the last decade, the company has delivered nearly 1,000 vehicles to the German Army, some of which have already been fielded in Afghanistan and Mali. Recent contract awards with the Bundeswehr also include 280 EUROCARGO 4x4 trucks to be delivered in 2018.

BARAK-8 Missiles for Israel's SAAR-6 Corvettes

(ck) Israel Aerospace Industries (IAI) will supply the Israeli Navy's SAAR-6 corvettes with the BARAK-8 air and missile defence system. The system will be used to protect Israel's exclusive economic zone and strategic facilities in the marine arena. The contract was signed by the Navy, the Directorate of Defence Research and Development (DDR&D) and the Israeli MoD's procurement administration. The BARAK-8 system was chosen because it meets the operational requirements and future challenges faced by the Navy. BARAK-8 is an air & missile defence system used by the Israeli navy as well as by the Indian navy and air forces. It provides aerial and point defence against a range of threats from the air, the sea or the land. The system integrates digital radar, command and control, launchers, in-

Photo: IAI

terceptors with modern RF seekers, datalinks and system-wide connectivity. The BARAK-8 was developed by IAI in collaboration with Israel's DDR&D, India's Defence Research and Development Organisation (DRDO), the navies of both countries, RAFAEL, IAI's ELTA Group and local industries in India.

Upgrades for ASIO Equipped Aircraft

(ck) BIRD Aerosystems, a developer of Special Mission Aircraft Solutions (ASIO) and Airborne Missile Protection Systems (AMPS), has been contracted to enhance the operational capabilities of the current fleet of ASIO-equipped aircraft of a South American customer. The operational enhancements include an upgrade of BIRD's MSIS Mission Management System to enable enhanced mission sensor operations, precise tracking of suspected targets and the use of advanced mission management algorithms which are expected to further reduce operator workload during the mission and therefore make the mission more

Photo: BIRD Aerosystems

effective. The upgrade will also enhance the SATCOM utilisation of the system, enabling communication via SATCOM to transfer system data dynamically as well as high-resolution videos. In addition, BIRD Aerosystems will add advanced task force command and control (C2) capability to one of the customer's ASIO aircraft, enabling high-level commanders onboard the aircraft to exercise command over task force missions from the air while also communicating in real time with the ground teams and the headquarters. The C2 aircraft will further enhance customer mission effectiveness by providing real-time situational awareness and decision-making to commanders both in the field and onboard the aircraft.

3D Radar for the Thai Air Force

(ck) Thailand has contracted Indra to supply the LANZA LRR 3D radar to the Royal Thai Air Force (RTAF). The contract includes the delivery of associated equipment such as Indra's AirDef, an air defence command and control system. The company will also provide a comprehensive logistic package including training to the Royal Thai Air

Photo: Indra

Force operational and maintenance personnel, plus spares and warranty. LANZA is a family of modular 3D radar systems with a scaleable architecture both in hardware equipment and software packages/capabilities. Sharing common logistics and life cycle support concepts, the LANZA family offers various configurations depending on user requirements. The multi-scenario, multi-role radars meet current NATO requirements and include advanced functionalities. All radar systems in the family are 3-dimensional, solid state, operate in L band, apply pencil beam exploration (electronic control in elevation of radiation beams), with distributed architecture and critical element redundancy allowing for soft-fail degradation in the case of certain items failure.

Power Management System for Military Batteries

(ck) Lincad, a UK-based manufacturer of batteries and chargers for military applications, developed a battery power management system, the BPMS Mk2. A 120Ah lithium-ion battery with the charge management and power routing electronics needed for self-contained UPS functionality, the BPMS Mk2 is designed to support a 24V DC power supply or act as a stand-alone 24V DC power source in demanding military environments. At 25 kg, it is a soldier-portable unit which is also suitable for mounting to mobile or static platforms. Its metallic IP67 sealed enclosure offers excellent electromagnetic screening as well as physical protection making the BPMS suited for use on equipment such as field artillery. Whether acting as a UPS or as a stand-alone battery, internal battery recharge is carried out automatically from most 24V power supplies. All voltage and current regulation circuitry is housed within the BPMS and recharge is automatic on connection of a suitable power source. Battery state of charge can be determined via a press to test membrane with a 5 LED capacity status display. The BPMS Mk2 has been designed as a form, fit and function replacement for Lincad's original BPMS which has been in service with the UK MoD for more than 12 years.

Photo: Lincad

Israeli DRONE DOME Answers UK C-UAS UCR

(ck) The UK has ordered six DRONE DOME systems from Israel's Rafael under an Urgent Capability Requirement (UCR) programme, providing a quick reaction counter-unmanned aircraft systems (C-UAS) capability. The first phase of the deal is worth US$20M and will be delivered this year. The British Army is the launch customer for the DRONE DOME system. The UK interest is focussed on engaging small drone targets (2-22 kg) at distances 500m or closer. The UK restricted the tender to mature systems (TRL8 or higher), and the order came only eight months after Rafael demonstrated the DRONE DOME's capability to the UK government in January 2018. Each system includes radars, electro-optical (EO) identification and signals intelligence systems and electronic jammers that disable the drone's datalink or navigation systems. The systems will be used to protect sensitive facilities from airborne threats. A complete DRONE DOME is compact and light enough to mount on an All Terrain Vehicle such as the TOMCAR (known as SPRINGER in service with the British Army). Rafael´s DRONE DOME integrates four RPS-42 MHR S-band multimission 90° hemispherical radars from RADA, and provides early warning and target tracks at ranges of 0.5 to 3 km. The MEOS electro-optical/infrared (EO/IR) surveillance sensor from Controp and Netline's NetSense Wideband RF detection sensors provide target identification. Target engagement by 'soft kill' is performed with electronic jamming, using the C-Guard RD jammer, system integration, command, and control. Deliveries of this programme are expected to be completed during 2018.

Photo: RADA

Electro-Optical Sensors for Offshore Patrol Vessels

(ck) As part of the SEA1180 project, SAAB Australia has selected Safran Electronics & Defence to equip 12 Offshore Patrol Vessels (OPVs) with the electro-optical sensor VIGY ENGAGE for the vessels' situational awareness system. VIGY ENGAGE is a lightweight, multisensor shipboard electro optic system. With its cooled infrared imager, video channels and laser range finder, it can deliver high quality images day and night, even in rough seas and at high speeds. The compact VIGY ENGAGE is easy to use and integrate and can detect targets at great distances which makes it suitable for port and infrastructure protection, anti-terror and anti-piracy missions, and fishing and economic zone protection missions. Some 300 VIGY ENGAGE systems have been sold worldwide.

Photo: Safran

ARGUS Soldier Systems for Canada

(ck) Under the Integrated Soldier System Project (ISSP), the Canadian armed forces will procure an additional 1,256 Rheinmetall ARGUS soldier systems to be delivered in 2019. The order is worth C$22M (€14.3M). The Canadian government initially commissioned Rheinmetall to start the qualification phase of the Canadian Army's Integrated Soldier System (ISS) in 2015, which has now been successfully completed. The final production phase of the ARGUS soldier system has already begun, with 1,632 units to be delivered this year. Rheinmetall has already developed the Bundeswehr's Future Soldier - Expanded System (IdZ-ES) and the GLADIUS 2.0 soldier system. All these systems integrate individual infantry soldiers, combat vehicles and unmanned systems into a tactical sensor-to-shooter network for faster and better decision-making at all levels; higher-level command elements can also be integrated.

Photo: Rheinmetall

Renewed CROWS Contract for Kongsberg

(ck) The US Army has contracted Kongsberg to produce the family of CROWS Remote Weapon Stations (RWS) and to provide system support and technical engineering support. The IDIQ (Indefinite Delivery/Indefinite Quantity) frame contract has a value of up to US$498M and extends over a five-year period. This is the third 5-year contract with the US Army for CROWS Remote Weapon Stations. Between the M151 RWS and M153 CROWS variants, KONGSBERG has delivered more than 15,000 RWS/CROWS systems to the US Navy, the US Marine Corps, and the US Air Force. The contract also includes the development of CROWS / RWS systems for air defence, C-UAS, and Force Protection. Additional development will include advanced control systems, expansion of on-going ATGM integration, air defence missile integration, non-lethal effectors (for escalation of force), as well as new weapons, including XM 914 (30mm x 113). The CROWS and RWS systems are produced in the KONGSBERG Johnstown, PA facility. With nearly 20,000 systems sold, KONGSBERG is numerically the world's leading provider of remote weapon stations.

India to Order Mini UAS

(ck) The Indian Army has commissioned Cyient Solutions (CSS), a joint venture between Cyient Ltd. and BlueBird Aero Systems, Israel, to supply the SPYLITE Mini-UAV. SPYLITE was developed to carry out real-time monitoring and target acquisition at very high altitudes. A battle-proven mini electric UAS optimised for covert, wide-area real-time visual intelligence, SPYLITE was the only UAV system to pass the Indian Army's test at extremely high altitudes. From launch to parachute rescue, the system offers reliable longevity and high operational availability in extreme weather conditions. In addition, SPYLITE offers rapid operational readiness, supported by launch and recovery at high altitudes and on rough terrain. Its low optical and acoustic signature make it suitable for covert operations. With high-end payloads, the system delivers day and night videos in high quality and range. The system can also be operated while the vehicle is in motion when the operator controls the UAV from a moving vehicle.

Photo: Cyient Solutions

Wearable Battery

(ck) Today's digital soldiers rely on tactical radios, ruggedised computing and navigation systems, night vision systems and gun sights which translates into multiple spare batteries of different kind and shapes that an infantry soldier must carry with him. Using conformal batteries to operate multiple different devices simplifies the logistics and the usage of batteries before, during and after a mission. Epsilor, a manufacturer of military batteries, developed a conformal wearable battery for digital soldier programmes at the DVD2018 show at Millbrook on September 19–20, 2018. Epsilor's battery is part of the VIRTUS new soldier system of the British Army, made by SOURCE Tactical Gear. SOURCE has integrated Epsilor's battery into the VIRTUS textile vest, placing it in the MOLLE hip battle belt to increase comfort. "Epsilor's batteries are packed in flat ergonomic flexible packaging that conveniently integrates into the soldier's vest," said Guy Harary, SOURCE Tactical Gear CEO. "The conformal battery is much more comfortable to carry, does not hinder soldiers' movements and enables the troops to carry out their mission without disruption." The batteries can power communications, tactical computers, sensors and additional devices. They offer high energy and high-power density as well as SMBus or one-wire communication protocols

Command Vehicles for French Army

(ck) The French Defence Procurement Agency (DGA) has bought a second lot of VT4 vehicles. A total of 4,380 VT4 will be equipping the Army by 2025, replacing the P4 liaison vehicle. Delivered by Arquus' industrial plant in Saint-Nazaire, the VT4 is a light and versatile, non-armoured, 4x4 vehicle for command and liaison purposes, designed to transport 5 soldiers or 4 operators equipped with the FELIN fighting system. Designed for domestic operations (Anti-terrorism Sentinelle operation, or training purposes), or foreign operations in stabilised conflict zones, the VT4 offers versatility and agility on all kinds of grounds. The vehicle has been fitted with many security systems, as well as all the equipment needed to save the soldiers' strength for operations, even after a long journey (air conditioning, comfortable seating, sound-proof compartment). The VT4 thus matches the latest generation of civilian vehicles, guaranteeing agreeable conditions for the soldier. The DGA also signed a services contract which includes a commitment to deliver 90% operational technical availability across the whole fleet. Arquus will be delivering 500 vehicles by the end of 2018. Production of the second series will begin as soon as 2019.

Photo: Arquus

Wind Tunnel Tests for the MQ-25

(ck) General Atomics Aeronautical Systems (GA-ASI), manufacturer of the PREDATOR, REAPER and GRAY EAGLE Unmanned Aircraft Systems (UAS), completed the fourth wind tunnel test of its MQ-25 design. MQ-25 is the US Navy's programme to develop an unmanned refuelling tanker which doubles the strike range of the Carrier Air Wing. During this recent low-speed wind tunnel test, the performance of the high-lift system and spoiler-based direct lift control (DLC) were verified in the presence of a heavily instrumented flow-through duct. The results were consistent with Computational Fluid Dynamics (CFD) predictions and verified the aircraft's ability to execute launch and recovery manoeuvres on an aircraft carrier. "The wind tunnel testing helps us to accurately predict the aircraft's suitability for carrier operations," said David R. Alexander, President, Aircraft Systems, GA-ASI. Previously, GA-ASI also carried out a high-speed test at NASA Ames' 11-foot transonic wind tunnel. Results from that test established the aerodynamic characteristics that are needed to verify the mission performance of the vehicle. Additional tests are planned during the EMD phase.

Upgrade to SPIKE ER Missile

(ck) At MSPO 2018 in Poland Rafael Advanced Defense Systems presented its SPIKE ER2, a 5th generation Extended Range missile, designed to enable Joint 5th generation tactical overmatch for ground manoeuvre, rotary dominance & naval deterrence. The new missile features a greater standoff range of up to 10 km for surface launch, and 16 km when fired from a helicopter. It also offers NLOS engagement capabilities (launch to target grid coordinate), low weight (less than 34 kg) and high lethality. The SPIKE ER2 is part of the SPIKE missile family, which is integrated on more than 45 platforms, in use by 30 nations, with over 30,000 missiles already sup-

plied and 5000 missiles fired. The SPIKE ER (Extended Range) variant, which has now been upgraded to SPIKE ER2, is the middle member of the family, with a range of 8 km, and a vast platform portfolio, including the Spanish TIGER helicopter, the Colombian

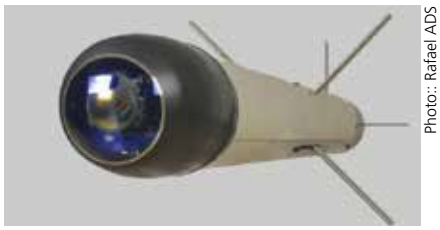

Photo:: Rafael ADS

Air Force BLACKHAWK, the Italian AW129 MANGUSTA, the Romanian SUPER PUMA helicopter, and various ground vehicles and naval vessels. The SPIKE ER2 includes a new RF datalink variant to maximise the missile's range for enhanced stand-off launch from rotary platforms, thus enabling its 16 km range. It also contains an advanced seeker with high resolution IR and day sensors for extended range target acquisition. SPIKE ER2 will be competing as the armament of choice for the German TIGER programme as well as for the Polish Army both as surface-to-surface vehicle-mounted stand-off precision guided missile (PGM) and as helicopter-launched PGM for the upgraded Mi24 and SOKOL fleet.

Operational Testing of STORMBREAKER

(ck) The Raytheon STORMBREAKER bomb, formerly known as the Small Diameter Bomb II (SDB II), has entered operational testing. Its purpose is to enable US Air Force pilots to hit manoeuvring targets in bad weather. The operational readiness test took place

Photo: Raytheon

in spring 2018 and operational test flights in summer 2018. The STORMBREAKER Tri-Mode seeker uses infrared, millimetre-wave and semi-active imaging lasers to allows pilots to destroy moving targets on the battlefield from a distance in adverse weather conditions. "With its tri-modal viewfinder and data link, STORMBREAKER will transform the battlefield by making adverse weather irrelevant," said Mike Jarrett, Raytheon Air Warfare Systems vice president. The STORMBREAKER will be deployed first on the F-15E STRIKE EAGLE and will be integrated into the F-35 JSF by 2022.

Extended Range UAS

(ck) Insitu, a producer of Unmanned Aircraft System (UAS), has developed a beyond line of sight, SATCOM-enabled small UAS capable of operating in modern combat theatres called INTEGRATOR Extended Range. INTEGRATOR ER shatters the line of sight barrier for small unmanned aircraft as it comes with an extended range of operations: 10 hours time on station at 200 nm and six hours at 300 nm. The UAS delivers high quality, full motion video on par with current ISR systems while flying at acoustically

Photo: Insitu

and visually undetectable altitudes. The UAS has a bandwidth throughput up to 10 megabits per second with a less than 1.5 second latency. INTEGRATOR has a reduced manpower footprint for operations; the system can be operated by a team of 12 operators, maintainers and mission commanders.

Protection from Heat-Seeking Missiles

(ck) Indra and Elettronica have joined forces to develop a next-generation solution that will protect any aircraft type from heat-seeking missiles. The aim is to produce a Quantum Cascade Laser (QCL) based Direct Infrared Countermeasures (DIRCM) suitable for the protection of rotorcraft and fixed wing aircraft. The system will be based on proprietary technologies from several EU countries and has been designated EuroDIRQM to reflect its European roots and its use of QCL technology for DIRCM purposes. The two companies have already completed the development of a prototype that was successfully tested in March 2018 by the Italian Air Force.
Quantum cascade is the latest development in laser technology and will reduce energy consumption and increase the speed and effectiveness of countering heat-seeking missiles. DIRCM systems are a self-protection solution to protect aircraft from heat-seeking missiles and from MANPAD missile attacks. The system detects incoming threat during the rocket launch and a countermeasure using a directed laser beam that deflects the missile from its trajectory. The entire process is fast and automatic, and the system can respond to attacks from any IR seeker with a disruptive sequence that ensures a successful countermeasure.In previous programmes, Indra and Elettronica have successfully applied their DIRCM capabilities to various platforms. Indra developed the InShield DIRCM system commissioned by OCCAR for the A400M ES fleet and commissioned in 2017 for the CH47 CHINOOK. Elettronica has developed the ELT/572 DIRCM, commissioned by the Italian Air Force and used on board their C-130J aircraft, and in the AW101 helicopter in combat search and rescue configuration.

Sensor Improvements

(ck) HGH Infrared Systems, best known for its SPYNEL-C and SPYNEL-M 360° thermal sensors, which are used as FOB protection and by special forces, presented its new technologies at MSPO 2018 in Poland: CYCLOPE 5.0, a new tracking function and the V-LRF option. The alarm management module CYCLOPE 5.0 automatically distinguishes between a threat and an authorised intrusion by analysing the behaviour of the target. In the event of a confirmed threat, CYCLOPE 5.0 automatically alerts and generates a visual alarm, sends an email or even a screenshot to the user. Another innovation is Automatic Tracking: the CYCLOPE software can now automatically track a threat in real time without the need for manual intervention; all the operator

Photo: HGH Infrared Systems

has to do is click on the target to start automatic tracking. HGH will also introduce the V-LRF option for SPYNEL-X and Spynel-S, which provides the sensors with a laser range finder for better detection.

Differing Views

EU Defence Ministers' Meeting in Vienna

Georg Mader

One of the first high-level meetings under the Austrian EU Presidency was the informal meeting of the 28 EU defence ministers and probably one of the last with the British presence in the person of Defence Minister Earl Howe. By November 2018 the EU will almost double the number of defence cooperation programmes within the PESCO framework to strengthen the military bloc, but the meeting reflected the differing views of members across the political divide.

The good news is that the EU is now considering many new projects under the PESCO structured defence cooperation programme and, according to EU Foreign Minister Federica Mogherini, will decide in November how to proceed. The European governments are already implementing 17 projects to improve cooperation between the member states in the field of security and defence.

Photo: Georg Mader

Federica Mogherini, High Representative of the European Union for Foreign Affairs and Security Policy and Austrian Defence Minister Mario Kunasek at the the Informal Meeting of Defence Ministers in Vienna, 29 August 2018.

In response to a question from ESD in this regard, Mogherini replied in the closing press conference: "All members are satisfied with the work; we have received 33 new proposals for PESCO projects which we are currently examining and which I believe will be ready for adoption in November." With a view to a possible further enlargement of a group of NATO nations together with Austria, Cyprus, Finland, Ireland, Malta and Sweden, Mogherini added that "the Union is taking a step-by-step approach to deepening cooperation and might consider inviting non-members to participate in future cooperation."

As regards the latter point, the Minister of Defence of Cyprus, Savvas Angelides, has formulated the conditions for the participation of third countries in PESCO programmes: The key conditions for future participation should be the prior conclusion of a "Security Intelligence Exchange" for classified information of these states with the EU and a technical agreement with the "EDA".

Host Nation-Led Project

As an example of how smaller but nevertheless important projects are implemented by a group of smaller states and their SMEs (small and medium-sized enterprises), Austrian Defence Minister Mario Kunasek, as host, presented to his colleagues CBRN-Saas: an action plan for a proposed 24x7 surveillance to raise awareness of chemical, biological, radiological and nuclear agents. The CBRN-SaaS (surveillance as a service) proposal is led by Vienna in cooperation with Croatia, Hungary, Slovenia, the Czech Republic and Slovakia (with the two future Austrian neighbours as observers) and is seen as "of high strategic value for the EU and NATO".

It is a proof of concept to create a CBRN situation picture based on a manned/unmanned ground/air sensor network. At the heart of the project is manned/unmanned teaming (MUM-T), which has been tested in early 2018 with the AIRBUS helicopter H145M and the Austrian SCHIEBEL S-100 CAMCOPTER UAV north of Vienna. The helicopter crew used the UAC several times for missions which are impossible for the helicopter and had the UAV transmit its sensor signals seamlessly to the manned platform.

Through PESCO, into which 25 of the 28 national armed forces want to integrate structurally, a defence capability is to be de-

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Photo: Georg Mader

Informal meeting of the 28 EU Defence Ministers, 29–30 August 2018

veloped outside or, as critics call it, "alongside" NATO. That is why there is much talk about military technical cooperation and joint arms development and procurement. In Vienna, the US "warning" to the EU to discriminate against American companies was also discussed, pointing to possible friction in transatlantic relations. But the national governments are willing to deepen defence cooperation, and in addition to issues such as military relations between the EU and the countries of the Western Balkans, they have issued several statements highlighting the need to restrict illegal migration and protect their borders.

Different Understandings of Borders

For centuries, the concept of borders has been obvious to everyone but lately, borders seem to have lost their evidence which has, of course, to do with the 2015 wave of migrants. The loss of control at borders is linked to the asylum system, which is still upheld by a shrinking majority of Member States. These states want to strengthen the external borders, but, because of the Schengen Agreement, they do not want to introduce border controls within the EU. It was therefore no surprise when Mario Kunasek submitted a proposal in line with Austria's "immigration ceiling".

"A Europe that protects"

Kunasek's non-paper includes proposals such as temporary military assistance to civil authorities in border control to cope with peak periods and exceptional situations in order to stop the illegal entry of migrants. It should be an interim solution. The aim is to strengthen the synergies of CIMIC (Civil Military Cooperation), in which Austrian troops have gained extensive experience and practical knowledge, both during long-standing "assistance missions" to police and customs at Austria's eastern and southern borders and during peace missions in the Balkans.
Additional regular troops as "forward-looking stabilisation" for border control is explained by the fact that border control in the EU is in principle a shared responsibility, but the main burden remains with individual countries which frequently lack civilian resources for this purpose. Based on the positive experiences with the Austrian "assistance model", the Austrian MoD has developed various "options" to transfer this concept to a European level and to put it on the table for discussion.
These options are designed to ensure effective border controls and manage migration peaks until FRONTEX is fully operational. EU Member States, third countries or even FRONTEX could benefit from this military assistance. The scope of military tasks would be governed by mandates and based on a national and international legal framework.
The options for military assistance and synergies in the protection of the EU's external borders would be in addition to the Common Security and Defence Policy (CSDP): Option 1 – support for FRONTEX, Option 2 – bilateral assistance to an EU Member State or Option 3 – use of military resources after mobilisation of the solidarity clause. These options do not provide for armed forces to act as "first responders" in border protection. Instead, their main task is to support the civilian forces that are earmarked by each Member State for this purpose.
These could be tasks such as providing transport capacity and medical assistance, training civilian and military personnel on the ground or setting up infrastructure such as access roads or shelters. But also tasks such as those of response forces: combatting crowds and insurrections, creating a safe environment, personal searches and surveillance and reconnaissance of the respective environment were mentioned. In general, Kunasek also stressed that an increase in European security also means an increase in expenses.

Restrained Responses

The Austrian proposal to deploy armed forces in border management is "useful", Federica Mogherini told ESD. "This could be the basis for more. All proposals calling for enhanced cooperation between civilian and military authorities are in line with the European approach and, in my opinion, are welcome." German Defence Minister Ursula von der Leyen was sceptical. Even before the conference she had stressed to the media that "border control and management under the German constitution is a purely police task in which the military has no role to play".
The cautious reaction of the German Ministry of Defence was of course noticed by the Austrians, who have a completely different approach to migration and border control,

Photo: Georg Mader

Illegal migration from North Africa to Europe threatens EU cohesion.

as Sebastian Kurz's new centre-right government took up the issue in 2017. Later, the German Embassy pointed out that von der Leyen only "referred to German borders and specific German issues, not to the overall approach of the Austrian proposal. Germany would "support all effective EU border protection measures and the improvement of cooperation between the civilian and military sectors".

Photo: MoD Austria

Exercise of the Austrian border police to protect the national borders

This Austrian proposal for the formal meeting of EU defence ministers on 20 November is thus on the table – in light of the fact that so far there is no EU regulation providing for the use of military force in internal scenarios. Or, as Estonian Defence Minister Yuri Luik said: "There are only a few theoretical ways to deploy the military to border areas. If you don't have a military conflict, everything should be regulated by the police." But the thing is, Austrians remember the TV footage of a few policemen being pushed aside by hundreds of migrants who stormed a southern border post in 2015.

Various EU Initiatives

On the other hand, there is another initiative supported by Germany that clearly mentions the EU's borders and Emmanuel Macron's "European Intervention Initiative" EI2. The aim of this initiative is to create a common strategic "culture" to enable EU members to better act together on future NATO, EU, UN or other ad hoc coalition missions. The initiative was initially supported by the defence ministers of France, Germany, Belgium, Denmark, the Netherlands, Estonia, Spain, Portugal and the United Kingdom. Finland said it wanted to join the initiative, and Italy initially also showed support, although it did not join the first announcement.

The French President wants EI2 to be a common European military intervention force in crisis scenarios, enabling troops to be deployed quickly to the EU borders, and he wants better information exchange, scenario planning and support operations. The project should be resource neutral and make use of existing resources and other forces that the members already have. In Vienna, no official statement was heard on EI2. Only the Bulgarian Defence Minister Krassimir Karakachanov commented that EI2 "is still too vague and only a political forum in which ideas are discussed. EI2 must develop and maintain more concrete dimensions. Bulgaria would not participate for the time being, and I have not heard that other European partners would."

Austrian Defence Minister Mario Kunasek mentioned another multinational or joint initiative. He explicitly stressed his support for the European Peace Facility (EPF), a new extra-budgetary fund of €10.5Bn for a period of seven years, which coincides with the next multiannual financial framework. The EPF, which was conceived and announced only in June by EU Foreign Minister Federica Mogherini as a package of measures to strengthen the EU's security and defence capabilities, would enable "the EU to become more efficient in military missions, but also to better support our partners in meeting our common security challenges," said Kunasek.

Kunasek added that a decision on any involvement of his country, which sees itself as neutral, is a matter for the Austrian government, but EFP would significantly improve the Union's ability to finance operational measures under the Common Foreign and Security Policy (CFSP) which have military or defence implications and therefore are not financed from the EU budget. On 12 June, the College of Commissioners decided to support the EPF proposal, which will now be submitted to the Council by the High Representative. The aim would be to set up this facility in 2020 with the first budget for 2021.

Kunasek also mentioned the European Defence Fund (EDF), €13Bn for cross-border investments in state-of-the-art interoperable technologies and equipment such as encrypted software and drone technology. In this context, he announced the conference "The European Defence Fund – Driving factor for defence research and innovation" on 2 October in Vienna.

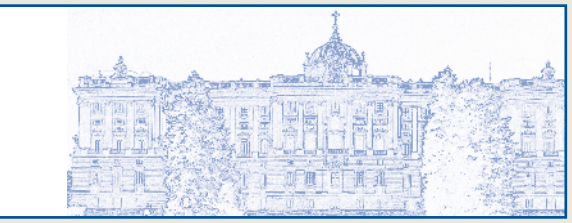
Italy Changed the Agenda

Italy illustrated in Vienna another and much more striking "rift" between EU members. Defence Minister Elisabetta Trenta, following the agenda of her new government in Rome, expressed her disappointment that the Italian proposal to amend the maritime anti-trafficking mission EUNAVOR-MED "SOPHIA" in the Mediterranean had not been taken into account. Italy's new Interior Minister Salvini wants to change the rules of the SOPHIA mission so that other countries besides Italy must take in migrants. "I am really disappointed, because I have seen that Europe is not here," Trenta replied to the question of whether Italy would leave the SOPHIA mission after no agreement was reached on changing the landing rules for SOPHIA. "I have found open doors, but also closed doors. Although I am convinced of the proposal, we will examine what needs to be done now. All decisions will be taken with the Italian Government and Prime Minister Conte."

Operation "Sophia" has so far rescued more than 49,000 migrants, but this must not mean "automatic" migration to Europe, as several European leaders such as Austrian Sebastian Kurz demand. Federica Mogherini said that, after hearing Ms Trenta, she wanted "a clear commitment from all EU Member States to continue the mission in the Mediterranean region. Although, in principle, the issue cannot be discussed by defence ministers and therefore no decisions were taken in Vienna, I wanted to see whether the Member States wanted to continue the mission. And I noticed that this was definitely the case".

Since migration flows to Europe cannot be managed by generals, a much greater effort than the involvement of defence ministers will be required.

However, migration and the associated danger of further "drifting apart" of the EU are on the agenda of the meeting of EU heads of state in Salzburg. How and in what form the European Union is progressing and whether the trenches will become canyons should be the main focus in the interest of security in and outside the EU. After all, in the end it's about "everything or nothing". ■



Viewpoint from Madrid

The First 100 Days of the Spanish Government

Esteban Villarejo

After the first hundred of the new socialist government, it can be said that Spain is maintaining its defence policy: The expenses planned by the previous centre-right government have been approved and there has been no change in international military missions with almost 3,000 soldiers in 15 operations.

Pedro Sánchez, the new Spanish president who won a vote of confidence in June and overthrew Mariano Rajoy (People's Party), quickly embraced a compromise to increase the defence budget to 2% of GDP (although Spain's forecast is to reach 1.56% plus other "contributions").

Sanchez had not wished for this compromise, but like all European heads of state and government he had to accept it at the NATO summit in Brussels when US President Donald Trump had set an ultimatum. The official NATO statistics show that Spain is currently investing only 0.9% of GDP in its defence.

The announcement of higher military spending is not meeting with great popularity in Spain, not least because of the upcoming local elections next year. For this reason, the socialist government has shown restraint in the first few weeks in order not to draw citizens' attention to the fact that it has just approved six major contracts for more than €4Bn, which is not bad for a president who claimed four years ago that he could govern without a Ministry of Defence.

On 20 July, the modernisation of the TAURUS cruise missile was approved (€30M). On 27 July, the government gave the go-ahead for a new budget to complete the construction of the future four S-80 submarines for the Spanish Navy (an additional €1.7Bn). On the same day the Socialists also launched a long-awaited programme: the two new military satellites Spainsat and Xtar-Eur (€1.4Bn).

On 3 August, a logistic contract was signed for €21,6M to support Air Force aircrafts and on 31 August Spain signed another contract for the acquisition of a new rescue helicopter SUPER PUMA As332 (€18M).

Finally, on 7 September, the Spanish government gave the go-ahead for the upgrade of the 17 Chinook CH-47 D for an estimated cost of €1Bn. Work will be done at the Boeing plant in Philadelphia.

"This new contract covers the purchase, renewal and modernisation of the CIS [Information and Communication Systems], the ground support teams, mission planning and simulation associated with the system, as well as pilot and mechanic training and technical documentation", the Council of Ministers stated.

In addition to approving these six major agreements, in the coming months Pedro Sánchez will have to approve the F-110 frigates (estimated at €4Bn), the 8x8 armoured combat vehicle programmes and the acquisition of new jet fighters to replace the Air Force's F-18 HORNET and the Spanish Navy's HARRIERs, although these last two decisions may await a next mandate.

We must bear in mind that President Sánchez rules thanks to a fragile coalition with Podemos (extreme left) and other pro-independence parties. The next parliamentary elections will take place before July 2020.

The Saudi Arabia Crisis

Another contested issue during these 100 days was the decision by new Defence Minister Margarita Robles (a former judge) to ban the sale of 400 laser-controlled bombs to Saudi Arabia because of concerns that the bombs might be used against civilians in the Yemen war.

These GBU-24 Paveway II bombs are part of a stock purchased by the Spanish Air Force in the USA. The cost of the transaction is estimated at €9.2M. Four NGOs had called for the export ban, but this jeopardizes a major contract for the national shipbuilder Navantia. Navantia wanted to build five corvettes for Saudi Arabia, a deal worth an estimated €1,8Bn. Some sources told E&D that there was a "state of shock" after Saudi Arabia decided to terminate the warship contract.

After a diplomatic crisis with Saudi Arabia, the centre-left government has revised its decision and will send the 400 laser bombs to Ryad. "There are no irregularities in the deal. We have been reviewing the contract for a week," said Foreign Minister Josep Borrell. So one minister is correcting another minister.

The Geopolitics of Energy

Energy Security in the 21st Century

Joris Verbeurgt

The existing world energy system was largely shaped by Anglo-American interests, which favoured market-driven competition over access to energy resources on a demand and supply basis. Global geopolitical shifts in the early 21st century have caused a profound transformation of this market-oriented system to which we need to adapt and react appropriately.

The geopolitics of energy comprises three dimensions: an economic dimension, an ecological dimension, and a security dimension.

The economic dimension of the geopolitics of energy is twofold: on the one hand, energy is indispensable for modern economies to produce and transport goods. There is a relatively straightforward relationship between energy and economic development, based mainly on the degree of energy self-sufficiency and on the composition of primary energy supply. On the other hand, energy resources are economic commodities themselves. The rise of the oil industry is interconnected with the rise of capitalism and international business, and fossil fuels are perceived as the driving forces behind technological advancement and economic power. In the twentieth century, the oil industry became the world's biggest business and the first globalised modern industry. The existing world energy system was largely shaped by Anglo-American oil companies that favoured market-driven competition over access to energy resources on a demand and supply basis, sensitive to price volatility. Due to internal and external dynamics, this market-driven system is undergoing profound changes in the early 21st century.

With regard to the ecological dimension, the use of fossil fuels by the industry, the transportation sector and households, is largely responsible for the environmental problems and the thereto related health issues of the past half-century: lead pollution, acid rain, fine dust pollution and, the most threatening of all, global warming and its consequences for the climate. As from the 1990s, more and more scientists claimed that fossil fuels were the principal cause of increases in atmospheric concentrations of greenhouse gases, driving up the mean temperatures of the planet and causing a worldwide melting of glaciers and of polar icepacks. Weather related disasters, like severe flooding or drought, gigantic hurricanes and tornados have rapidly risen since the 1990s. The possible consequences of the continued and increasing use of fossil fuels forces stakeholders in the fields of security and defence and policy makers to take these global disastrous effects into account when discussing energy related issues. Where traditional geopolitical thinking regarding energy focused on availability, reliability and affordability, modern geopolitics of energy involves sustainability as well.

Photo: U.S. Airforce

Conflicts over energy resources endanger the global balance of power.

Energy Security

Energy security is the third dimension of the geopolitics of energy. There are no uncontested or universally accepted definitions of 'energy security'; it is a broad, evolving concept, encompassing many elements and aspects the importance or significance of which can alter in relation to the viewpoints, backgrounds or scientific expertise of the person using the definition. Moreover, 'geopolitics of energy' is often narrowed-down to 'energy security' and both concepts are often used as if they were interchangeable.

The origins of energy security date back to the beginning of the industrial revolution. Energy was a vital source underpinning industrial growth, modern technological life and economic development. Energy was, and is, tremendously important in every field of life and is a primary concern, second only to national defence, for the survival and well-being of developed and developing nations and societies. It is no surprise, then, to see that the control over energy resources (oil, gas, coal, nuclear or renewable) is at the heart of great power politics.

The intertwining relations between oil, politics and international power first became evident during the First World War, when Great Britain, due to German submarine warfare, experienced severe

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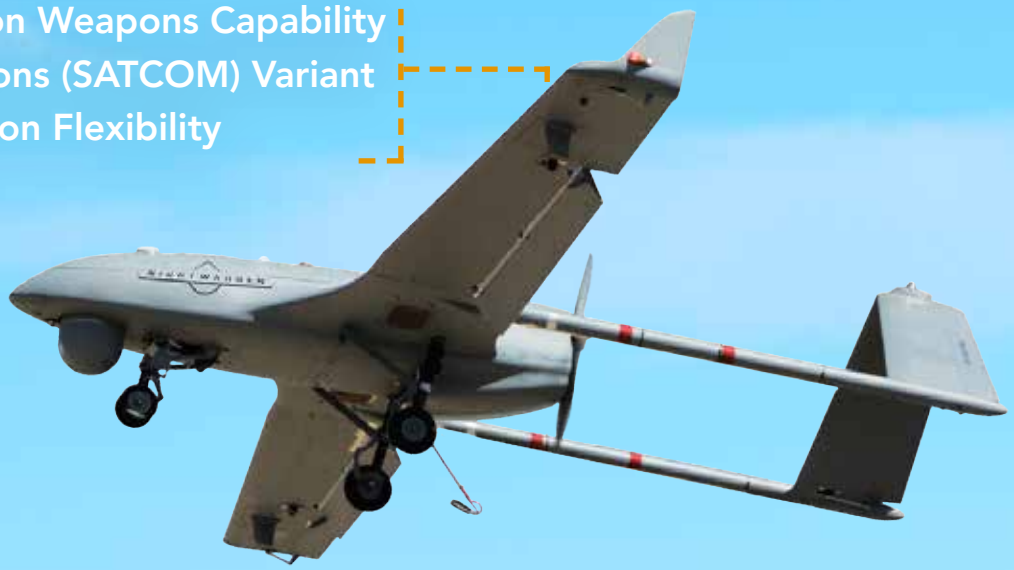

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shortages in oil supply which threatened the entire war effort. With the beginning of the war, the combustion engine had gained prominence (in warships, airplanes, and mechanised transport) which increased the dependence on oil as a premier energy source. The Allies, under the impulse of First Lord of the Admiralty Winston Churchill, quickly realised the importance of a secure and uninterrupted supply of oil at a reasonable price. They figured out that the control over energy resources and their secure transportation to energy markets would also be vital to their post-war existence and influence. This gave rise to the concept of energy security, and energy resources gained a prominent place in the war and postwar strategy. During the First World War, the Allies altered their strategic objectives with regard to the Caucasus, the Middle East and the Ottoman Empire in the light of the presence (or absence) of oil reserves. Regions previously neglected by foreign policy (e.g. the Saudi Arabian

Graphic: US EIA

Many EU member states are heavily dependent on Russian gas and oil supplies.

peninsula) now attracted the attention of politicians, entrepreneurs and the military. In the Second World War, the control over vast energy reserves was an important determinant of the Axis strategy: Stalingrad was a result of Hitler's desire to gain access to the energy-rich areas on the Caspian Sea, while the American oil embargo against Japan was one of the main events that led directly to the attack on Pearl Harbor.

Ever since, securing energy resources is a key aspect of foreign policy making and of military strategy.

Photo: US State Department

To avoid conflicts over energy the US set up the US-China Economic and Strategic Dialogue Joint Session on Energy Security. Pictured are former US Secretary of State John Kerry conducting talks with Chinese Vice Premier Wang at the US Department of State on 10 July 2013.

Energy Security in the Modern Era

While in the previous decades wars were fought over oil, the 1970s confronted the oil consuming countries in the West with a frightening new reality: oil used as a weapon When after the Yom Kippur war and its aftermath (1973/74) the Organization of Oil Exporting Countries (OPEC) decided to boycott the major energy consumers in the West, the crisis that followed brought the importance of energy security immediately to the attention of governments, businesses and ordinary citizens. The message was clear: energy security became a matter of international as well as national concern.

The collapse of the Soviet Union two decades later enabled a shift from a high dependency on petroleum to a more diversified energy package: natural gas and renewable energy became significant players in the energy picture, although petroleum keeps occupying a prominent place in the geopolitics of energy.

Shortly after the fall of the Berlin Wall, Anglo-American energy security policy strived at controlling most of the world's energy resources and at securing the lines of supply from producer to consumer. The free market model, based on demand and supply, favoured the Western energy consuming powers and became the blueprint for a global energy system, aimed at (relative) price stability. The oil producing countries in the Middle East were the cornerstone of that system and Western powers did not hesitate to use military force in order to consolidate their supremacy. The two Gulf wars against Iraq (1990-1991 and 2003) and the intervention in Somalia (1993-1995) to protect the Strait of Hormuz, vital to Western (and global) energy security, are just a few examples.

New Geopolitical Challenges

The beginning of the 21st century is characterised by uncertainty and a changing energy landscape. The vulnerability of the whole energy sector can be described as the Achilles heel of the developed world and some predict yet another transition of the energy paradigm. Five trends can be identified as the driving forces behind this transition:

On the demand side, we see a diminishing role for the US in shaping oil markets due to the increasing oil demands of the rising Asian powers, notably China and India. It is argued that the Anglo-American market-based model is losing terrain to the petro-mercantilist approach of China and to the energy-hegemony approach of Russia. The Chinese petro-mercantilist model seeks to lock-up exclusive access to oil and gas reserves wherever it can obtain them. Chinese companies are also trying to buy Western energy companies in their hunt for energy resources and technology. Foreign policy and the search for energy needed to sustain economic growth, are intertwined through the (quasi-) state owned energy companies like SinoPec. The Chinese meddling in Sudanese internal affairs like in the Darfur region – a region rich in fossil fuels - is a classic example of that policy. The Russian energy-hegemony model suggests that Russia uses its enormous reserves of oil and natural gas and its geographical position to advance its foreign policy goals by bribing or bullying both suppliers (in Central and Southwest Asia) and users (the EU). At the same time, Russia uses its energy companies – of which energy giant Gazprom is the most notorious - to exploit the free market.

On the supply side, rising demands and supply constraints lead to price volatility. The world is running out of fossil fuels, although real shortages are not to be feared for in the near future. Largely

due to the disclosure of new reserves (shale gas, for example) and to the use of new technologies that make the exploitation of these reserves profitable, scarcity is not as big as anticipated a decade ago. However, the days of energy abundance are definitely over. Assessment, production, conversion and delivery to where resources are needed in a cost-effective, secure and environmentally benign manner, have become a real challenge. The infrastructural needs to transport larger volumes over larger distances through already crowded and vulnerable choke points are another concern.

Political instability in and around countries that play a role – even a marginal one - in the worldwide energy system cause major price spikes on the market. Instability creates fear among oil importers and gives political power to oil exporters.

Terrorism is yet another factor increasing uncertainty with regard to energy security: the attacks of September 2001 have inspired different terrorist groups to new forms of terrorism. Since 2001, worldwide attacks on oil or gas pipelines and on other energy related infrastructure are increasing. This so-called 'economic jihad' threatens the safety and security of energy resources and has become another important security challenge for both industry and governments.

However, climate change may be the biggest challenge to energy security; global warming poses by far the most important challenge to today's geopolitics of energy. Climate change will profoundly affect energy systems and the possible catastrophic consequences raise enormous macroeconomic security concerns in terms of disrupted methods of production, reduced household's purchasing power, drops in consumer confidence and, finally, reductions in economic activity. National security concerns, such as uncontrolled mass migration, as well as affordability of energy, will add to the problem.

NATO and Energy Security

NATO discovered energy security at the Bucharest Summit in 2008. Although energy security is largely non-military in nature and mostly a national responsibility, NATO understood that the energy developments mentioned above will have serious security implications. NATO could not turn a blind eye to the protection of critical energy infrastructure and should enhance energy efficiency in the military as well.

Energy security, with numerous implications for allied security, became a real strategic issue for NATO in the aftermath of the Russian annexation of the Crimea in 2014. For many NATO allies energy supply is a challenge. In March 2014, NATO Secretary General Anders Fogh Rasmussen declared that Europe's dependency on oil and gas imports was increasing at a time when the energy needs of rising powers such as China and India were rising as well. Political instability was haunting many energy-producing and transit states, while the quest for energy and other resources had sparked territorial disputes all around the world. Terrorist and cyber attacks against refineries, pipelines and power plants occurred in many countries, as

well as piracy along critical maritime choke points. NATO's energy security agenda is aimed at creating awareness of global and regional energy developments and supporting the political consultation process with shared intelligence. Although NATO's contribution to energy security is limited to analysis and consultation, it has become a permanent fixture in NATO's education and training programmes. NATO sees a role for itself in the three following areas:

1. Raising awareness by sharing intelligence on energy developments, by fostering political consultations among allies and partners and by exchanging information and insights with outside experts.
2. Supporting the protection of critical energy infrastructures by sharing best practices, by organising training courses and by inserting energy-related scenarios into exercises.
3. Enhancing energy efficiency in the military by the sharing of national best practices, by using energy-efficient equipment and by developing military energy efficiency standards.

In the near future, NATO will also focus on the energy resilience of the allies. Since resilient energy supplies are vital for collective defence, NATO support in this area is likely to increase. Cyber threats towards energy infrastructure will also gain in importance.

In order to take up these roles, NATO created several organisms: an Energy Security Section was established within NATO's Emerging Security Challenges Division. The Energy Security Section works together with outside experts and with the International Energy Agency (IEA) and with the Directorate-General for Energy of the European Commission. In 2012, a NATO Energy Security Centre of Excellence was established in Lithuania, providing analysis and training across the entire spectrum of NATO's energy security agenda and serving as a unique asset for supporting and promoting NATO's energy security agenda. In 2015, the first Energy Security Strategic Awareness Course took place in the NATO School in Oberammergau, covering a broad spectrum of energy challenges, ranging from the geopolitics of oil and gas to enhancing the energy efficiency of armed forces. And recently, in February 2018, NATO held its first energy security course at the newly created NATO-Istanbul Cooperation Initiative Regional Cooperation Centre in Kuwait. Several partner countries, notably Ukraine, attended the training course on the protection of critical energy infrastructure.

Photo: Joachim Kohler

Diversification of natural gas supplies, including liquefied natural gas, can reduce energy dependency.

It is clear that NATO's role in energy security will remain modest, but that it is an essential part of the Alliance's toolkit and energy developments are too intertwined with other security issues to allow NATO to ignore them.

The EU and Energy Security

For the EU, energy security is a matter of life and death. The EU imports more than half of the energy it needs and its import dependency amounts to 90% for crude oil and 69% for natural gas. A gas dispute between Russia and transit country Ukraine in 2009 threatened many EU countries with severe shortages and highlighted the vulnerability of the EU for supply disruptions and infrastructure failures. Even more, many EU countries rely on a single supplier – some countries rely solely on Russia for the import of natural gas. With a total energy import bill of more than €1Bn a day, it was necessary for the EU to draw up an energy strategy and in May 2014, the European Commission released its Energy Security Strategy. The aim of the strategy is to ensure a stable and abundant supply of energy for European citizens and the economy. The Strategy proposes actions in five key areas:

1. Increasing energy efficiency in order to reach the proposed 2030 energy and climate goals, with the focus on buildings and industry.
2. Increasing energy production in the EU and diversify supplier countries and routes. Negotiations are taking place with Russia, Norway, Saudi Arabia and countries in the Caspian Sea region. Another option for diversification is the increased import of US liquefied natural gas. Safe nuclear energy and renewable energy sources should also contribute to an increase in European energy production.
3. Completing the internal energy market and building missing infrastructure links that allow a quick reaction in case of supply disruptions. In July 2018, measures were taken to better integrate the Iberian Peninsula into the European energy market.
4. Building an external energy policy, including sharing information about national planned agreements with non-EU countries that may affect the EU's security of supply.
5. Strengthening emergency and solidarity mechanisms and protecting critical infrastructure by a more efficient use of storage facilities, by developing the possibility of reverse flows, conducting risk assessments and putting in place security of supply plans at regional and EU level.

The final aim of the EU energy strategy is to create a real energy union, making energy more secure, affordable and sustainable. To achieve that goal, the EU wants to facilitate the free flow of energy across borders and a secure supply in every EU country. New technologies and renewed infrastructure should contribute to the ideal of a sustainable, low carbon and environmentally friendly economy. Therefore, the European Energy Security Strategy was completed by the 2030 Framework for Climate and Energy.

Energy security is becoming an important issue for NATO and for the EU and plays an important role in the relations with Russia. However, it still largely remains a national responsibility, and nations are reluctant to give up their sovereignty in that vital field of interest. It remains to be seen how energy security will be managed in the future by the member states, NATO and the EU. ■

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Armenia's Endangered Revolution

Stephen Blank

Armenia's revolution in April-May 2018 generated possibilities for real economic and political progress and regional peace. Neither the new Armenian government nor the West should obstruct this chance.

Nothing is more critical to the success of this revolution to purify Armenian politics than that the West help it make peace with Azerbaijan and end the war over Nagorno-Karabakh. This connection between the domestic and foreign policy elements of the revolution is intrinsic to its success. Indeed the revolution triumphed because Russia did not intervene on behalf of the discredited old regime. Moscow evidently accepted that the revolution's leader Nikol Pashinyan meant what he said that stated that the revolution "had no geopolitical agenda" and showed that he could then control the revolutionary movement. Indeed he and his new government repeatedly stated that Armenia would not change its foreign policy course of membership in the Eurasian Economic Union and the Collective Security Treaty Organisation or create difficulties with Russia. Neither would Russia create difficulties for the new government. And since taking power he has reiterated his government's commitment to improving ties with Moscow.

The Nagorno-Karabakh Conflict

Moreover, Pashinyan initially had little choice because Russia also dominates Armenia's economy, making any moves out of Russia's embrace prohibitively costly. However, as this writer has stated, this victory carries a risk, because if Armenia cannot end the war over Nagorno-Karabakh with Azerbaijan, it will not only remain under Moscow's heels, but also its promise of democratic progress and economic growth will not materialise. In other words, peace is a precondition for a broad Armenian and even regional economic-political advance.

Author

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Photo: Raffi Kojian

On 22 April 2018, tens of thousands of Armenians gathered in Republic Square in Yerevan to demand the resignation of Serzh Sargsyan from his post as prime minister.

There are at least four reasons for making this argument. First, consolidating more democratic governance than was previously the case in Armenia or elsewhere during wartime is an inherently problematic endeavour. And the war in Nagorno-Karabakh easily lends itself to the contention that it is a war where Armenia's national identity if not survival is at stake even though that is not the case. Moreover, there were and are more signs that many see the revolution as a kind of war, as an expression of aroused Armenian patriotism, although this is not the case. Given the problematic nature of bringing an end to any war, the entanglement of identity issues makes it even more difficult to end this war solely through the actions of the warring parties. And the longer it goes on the more likely that war fever will carry to power elements of Armenian society that have aims inimical to those of the revolutionary forces. Therefore foreign support is essential. The second reason why continuing this war multiplies the difficulties involved in bringing more liberal, transparent governance and economic prosperity to Armenia is that the war has hitherto hijacked Armenian politics. Those elements who have profited from the war have used wartime politics and extended state controls to enrich themselves, corrupt Armenian economic-political institutions and entrench themselves in power even if popular outrage cost them the government this time. To the degree that the war

continues and deflects popular emotions away from the arduous "slow boring of hard boards" needed to effectuate a radical change in structures of policymaking and governance it will corrupt domestic politics, possibly add a new layer of corrupt elites on top of the old one, and invariably preclude the improved transparency and democratic reforms promised by Pashinyan and his colleagues.

A third reason why ongoing strife will obstruct realisation of the revolution's promise is that its continuation ensures Armenia's continuing international isolation and thus inhibits prospects for economic resurgence. It cuts Armenia off from regional infrastructure and energy initiatives launched by Turkey and Azerbaijan that connect those countries with Europe. Even now, those governments are completing major infrastructural projects that bypass and therefore isolate Armenia. Thus Armenia's opportunities for genuine economic cooperation at the regional level and integration with Europe are blocked and will remain blocked as long as the war goes on.

Clinging to Moscow

That situation ineluctably leads to the fourth reason why the war is inimical to the promise of the revolution. The exclusion of Armenia from Europe and its sense of a permanent threat to its survival and national identity has made it embrace Moscow unreservedly and continues to make it do so. Paradoxically, its embrace of Moscow generated a loss of its real sovereignty in domestic and foreign affairs, as much of its economy is under Muscovite control and Moscow's military base at Gyumri evokes old-fashioned imperialism with its 99-year lease. Armenia also depends on subsidised weapons purchases and imports from Moscow. All this has given Moscow a whip hand in this conflict and the Caucasus as a whole that it is of no mind to yield. And its control over Armenia has enabled it to form alliances with Armenian domestic elites who depend on Russia for their position. Many foreign observers argue that the longer the war lasts, the more likely the flood will turn against Armenia because Azerbaijan has superior economic capabilities and connections abroad, which is why these Armenian elites have ample reason to be even more reliant on Russia. Meanwhile the new government's initial moves on Karabakh cited below and announced intention to give ties to Russia a new impetus reinforce those trends. This being the case, Armenian elites not only have no foreign policy alternative as they see it beyond cleaving

Photo: Kremlin

Russian President Vladimir Putin with Nikol Pashinyan, the newly appointed Prime Minister of the Republic of Armenia, 14 May 2018.

to Moscow, the sources of their domestic wealth and power are at risk without subordination to Russia. Armenian elites are therefore unwilling to sponsor reform and enhanced transparency, amongst other dreams and demands of the revolution, to any but a minor degree and if unchecked they have the power to obstruct both peace and reform in Armenia with Russia's concurrence. Moscow, for its part, also sees reform as a virus that will contaminate Russia if allowed to grow — the same perception and motive for action underlay the invasion of Crimea and the Donbass. So while it tolerated Pashinyan's ascension to power over a regime that had lost any hope of domestic support, it will vigilantly monitor events in Armenia and undoubtedly intervene if its feels its interests are in danger. Consequently while the new Armenian government has made some promising moves like curbing the corruption of its armed forces and the many independent armed groups there, the revolution will eventually suffocate if it cannot break free of Moscow who has no interest in genuine reform in Armenia or elsewhere in the former Soviet Union.

A Wavering West

Therefore for the revolution to realise its promise, at least in part, it must obtain foreign help to end the war, generate economic and democratic progress, and relax Russia's reins upon it. For that to happen, the West has to see the advantage of brokering a peace in Nagorno-Karabakh and act on that insight to curb Russian imperial adventures in the Caucasus and advance the cause of democracy. Moreover, a Western move in the Caucasus would also play well in Ankara which clearly grasps Russia's threats to Turkey through its efforts to destabilise the Caucasus. In turn, that might help ameliorate the very badly strained Western relationship with Turkey, because it would create a basis for genuine cooperation between them.

Yet there are disquieting signs that the West is not moving forward with sufficient vigour or seeing its opportunity since nothing is being said about a Western initiative to move the war towards peaceful resolution. Despite encouragement to Armenia and signs of a willingness to advance economic assistance to Armenia, these moves are limited, unimaginative, and do not get to the root of the problems afflicting the Caucasus. Economic support and words of encouragement, though useful and necessary are insufficient in the current environment. Consequently, Armenia is falling back into subordination to Moscow. Armenia supported Moscow's position on retaining its troops in Moldova when the UN recently voted against that aggression. Armenia also supports Moscow's position on Abkhazia and South Ossetia, the provinces it tore away from Georgia in 2008, and thus Armenia, in trying to placate Russia, undermines its own traditional friendly relations with Georgia. These positions reflect Yerevan's dependence upon Russian support but they also undermine the very ideas of national sovereignty and territorial integrity upon which Armenia as a country must base itself and thus further compromise both its sovereignty and integrity as well as its claims for retaining Karabakh. Indeed, supporting Moscow's conquests in Georgia and machinations to incorporate those territories into the Russian Federati-

on directly contradicts the principles of independence and sovereignty upon which the revolution must base itself to succeed. Since Pashinyan is undermining his position, the claims that this government is a truly democratising one leave much to be desired. While there has been progress, the whole idea of a democratic, prosperous Armenia connected to Europe remains very much at risk. But Armenia can only move forward on its reform projects if the West launches an initiative to unblock the frozen negotiations over Nagorno-Karabakh for only that will reduce the leverage of armed forces and corrupt profiteers who have gained pre-eminence in Armenian politics due to the war. A western initiative breaks the logjam that ties together Russian and corrupt Armenian elites' domination of Armenia's domestic and external policy agendas and offers Armenia as well as Azerbaijan another alternative.

Photo: Koch / MSC

Former Prime Minister Serzh Sargsyan at the Munich Security Conference 2018, two months before his resignation

Otherwise, the outcome is likely to be another abortive revolution and stagnation at home with no resolution of Nagorno-Karabakh or genuine integration abroad. That outcome reinforces the inherent instabilities that have come to characterise Armenia's trajectory over the last generation. Armenia's structurally induced long-term stagnation not only was a cause underlying the many explosions culminating in the revolution earlier this year; it also is a major reason for the mass emigration of young people who find the situation hopeless. Therefore, it is no exaggeration to say that Armenia's future depends on finding an end to the war.

Russian Geopolitics

We can be sure that Moscow will do nothing to bring about an end to the war. Its policies here, as everywhere else, revolve around manipulating the tensions generated by the war and preserving them for its own benefit. Indeed, as foreign analysts have observed, Moscow neither can nor will play a stabilising role on its periphery and thus it thrives by exploiting the many conflicts around its periphery and in which it is involved abroad like Syria. Indeed, Russian analysts have come round to the belief that the management of ongoing conflicts in not only the former Soviet Union, but also what Andrei Korybko calls "Afro-Eurasia" is a precondition for a major element of Russia's strategy for preserving its standing as a great global power. Korybko observes that Russia's 21st century grand strategy is all about becoming the supreme "balancing" power in Afro-Eurasia through the skilful diplomatic management of the hemisphere's multiple conflicts, though the greatest danger to this vision comes not from the hybrid wars of the US, but from Russia itself if its diplomatic and expert community representatives don't rise to the occasion in properly explaining this strategy to the masses.

This statement applies as well to Armenia as it does to Africa, the subject of Korybko's article. It illustrates a general truism of Russian foreign policy that applies to the Caucasus, Middle East, Africa, and so on, namely that Moscow can only assert and maintain its great power project by inciting or exploiting conflicts on its periphery and deliberately calibrating them over time to prevent either an explosion or a resolution of them. As Susan Stewart of the German Stiftung Wissenschaft und Politik writes, "Russia is more than willing to tolerate instability and economic weakness in the neighbouring countries, assuming they are accompanied by an increase in Russian influence. In fact, Russia consciously contributes to the rising instability and deterioration of the economic situation in some, if not all, of these countries."

Therefore, if for no other reason than the desire to avoid and eliminate future sources of conflict in and around Europe, the West needs to offer the Caucasus something more than continued Russian strong-arm tactics, because these conflicts will not always remain frozen. Indeed, many observers have argued that the war in Nagorno-Karabakh, due to the quality of the weapons being introduced and the large-scale Azeri defence spending that will, Baku believes, over time give it preponderance, will reignite and become much more dangerous. But at the same time the West has a serious interest in helping Armenia maximise its new opportunities by materially stimulating its regeneration through reform and improved, more democratic governance, and economic integration with the European civilisation that Armenia rightly accounts itself part of. Not only do such states provide better lives for their citizens, they also are less likely to go to war. And wars like that of Nagorno-Karabakh are inevitably destabilising not only for the domestic governance of the states involved but also for the region. It is already the case that in 1993 this conflict generated threats of nuclear war or World War III as a way of deterring Turkey's potential intervention on behalf of Azerbaijan. Consequently the heightened episodes of serious war fighting that occurred in 2014–17 rightly alarmed observers and Moscow, both of whom saw the real potential for this conflict to erupt into a much wider regional conflagration. Therefore Moscow acted to mediate those conflicts.

A Frozen Conflict

However, the Pashinyan government's initial steps here have done nothing to calm the waters and may well have rekindled new tensions that could undermine itself

and the Caucasus' chances for genuine progress. Pashinyan's expressed desire that Karabakh be represented as an independent participant in the Minsk process to negotiate an end to Nagorno-Karabakh was a provocative non-starter, since Baku would refuse to negotiate under those circumstances. In another example, it was only after Azerbaijan obtained missiles from Belarus and Israel to counter Armenia's ISKANDERs procured from Russia that Armenian Foreign Minister Zohrab Mnatsakanyan publicly advocated that the EU and Eastern Partnership countries, including Armenia and Azerbaijan should refrain from actions that foster a regional arms race. Obviously this was too little too late.

Therefore, if Western governments truly want to promote the Armenian revolution and help it realise its potential for a freer, more democratic, and more prosperous Armenia then they have to step up their game in the Caucasus. Otherwise, as we are already seeing, Armenia will relapse into the old course of blindly supporting Moscow and being corrupted by its influence and that of Moscow's agents and subordinates in Armenia who cannot reconcile themselves to a new order of things in that country. In other words, Western governments need to be able to help Armenia become democratic; otherwise, it will not end the war with Azerbaijan, not realise its democratic promises, and remain a Russian satrapy.

And that is a recipe for continued warfare and conflict in the Caucasus. And since security in the Caucasus is, in fact, inextricable from European security, Western failure here will reverberate around the Black Sea and Europe just as the unlearned lessons of Russia's war of aggression against Georgia in 2008 continue to haunt European security.

Indeed, Baku, which had adopted a wary neutrality with regard to the revolution when it occurred to avoid charges of interference in Armenia's domestic politics, has registered its dislike of Pashinyan's nationalist and one-sided policies. Since Azerbaijan depends on foreign arms imports, Armenia's call for the EU and Belarus to cease contributing to an arms race while omitting Russia, Armenia's sole source of weapons and prior refusal to call for a general end to the arms race in the Caucasus, not only led Baku to consummate its foreign missile acquisitions, it also has led President Aliyev to say that the war has not ended, rather only phase one has ended and that army building is "the utmost priority". This is a stance that benefits nobody, since it adds to already excessive tensions, but it clearly represents both the new government and the West's failure to seize another opportunity.

These steps indicate that without a real Western impulse Armenia will not embrace the democratisation opportunities created by the revolution. That would be bad enough. But just as peace is necessary for the revolution to succeed, it is highly likely that the absence of peace not only puts the revolution at risk, it also raises the possibility that this conflict, which already shows signs of being close to erupting, may well descend into renewed fighting. Only Moscow benefits from that outcome if anyone does. And since we have long since established that security in the Caucasus is inextricable from overall European security and the threat of World War III was already invoked here in 1993, in fact there is not a moment to lose to save this revolution and pacify the Caucasus. ■

Viewpoint from Tbilisi

After Decades of Erosion of the Euro-Atlantic Security Structure ...

Beka Kiria
Director of the Gagra Institute

When we discuss Euro-Atlantic security arrangements, three numbers with 8 – 08/08/08 – accidentally symbolise the Euro-Atlantic security structure. These three figures represent the beginning of the erosion of Euro-Atlantic security after the Second World War and the Cold War.

This year Georgia celebrated the 100th anniversary of the Republic of Georgia. Almost every decade in the last two centuries Georgians have risen to regain independence and sovereignty. As early as 1921, the brutal Bolshevik occupation of Georgia ended the bright days of the most progressive social democratic state in Europe and Georgia was chained to a dystopian experiment for about 70 years. After the collapse of the Soviet Union in 1991, Georgia together with Ukraine regained its independence and began to revive its relations with the Western world.

The newly independent countries of Georgia and Ukraine have travelled the long and shaky path of NATO enlargement that they embarked on in 1994 to become members of NATO and the European Union. Both countries sought to gain access to the Western security structure in order to play an active role in the post-Soviet space, also known as the "Russian sphere of influence".

From an idealistic perspective, the three-year history of the Georgian and Ukrainian struggle can be presented as an idealistic but uncertain struggle in which national politicians believed that belonging to the Euro-Atlantic economic and security structures would ultimately bring peace and prosperity to their countries.

Georgia and Ukraine were first promised a large carrot. Georgia was praised for being among the fastest growing economies in the world and because of its thorough reforms in digitisation, defence and police transformation, education, and the economy. By building new institutions, these countries broke with the Soviet legacy.

Georgia's successful reforms and the internationally renowned success story in the Kremlin's "backyard" inspired many Russian and other post-Soviet citizens. At the NATO summit in Bucharest NATO member states clearly stated in the communiqué that Georgia and Ukraine would become NATO members.

For the Kremlin regime, Georgia as a shining example of a post-Soviet country, was to Russia and Russian citizens a threat. During the 2008 Olympic Games, Russia instructed the military to neutralise Georgia's rapidly growing success story and promising democratisation. In August 2008 the country lost 20% of its territories. That would be like a foreign military separating California, Nevada, Texas and Montana from the USA or Bavaria and Saxony from Germany. Through diplomatic pressure, the USA and European allies succeeded in saving Tbilisi, the capital of Georgia, from Russian occupation.

The Russian occupation of Georgia merely provoked verbal criticism from the West. Later, in the light of Obama's "New START" policy, Western criticism of Russia subsided to some degree. A New START treaty provided for a 30% reduction in the number of operational strategic warheads to 1,550 and a 700-strong limit for ICBMs and SLBMs. Obama has primarily tried to work with Russia to address world security challenges, such as urging Russia to work together on sanctions against Iran and North Korea.

For the sake of Euro-Atlantic security and international law, however, the West could not give a red light to Russian actions and force the Russian military to withdraw to its old bases, even though Nicolas Sarkozy had brokered such an agreement with Russia. Instead of protecting the international legal order and facing the challenges of the Euro-Atlantic security structure, the Obama administration initiated a policy of appeasement against Russia to renew cooperation and tackle nuclear programmes in Iran and North Korea. The Kremlin saw Washington's leniency towards Russia over the occupation of Georgia and the attack on the European security structure as a reward for cooperation in resolving global nuclear issues.

In practical terms, Euro-Atlantic security planners, politicians and decision-makers separated the Georgian issue and drew a dividing line between European security and the Georgian question in order to ensure "business as usual" with Russia. Even from a cost-benefit perspective, the political calculation of the West – ignoring the Georgia/Ukraine issue in order to benefit from nuclear cooperation between the US and Russia – was at least questionable.

Russia, which is not a member of NATO, opposed the eastward expansion of the Euro-Atlantic security architecture, which is supported by Germany and France. The Bucharest Summit had promised in its communiqué that these countries would one day become NATO members. By failing to reach consensus on Georgia and Ukraine, Euro-Atlantic politicians increased the likelihood of future threats.

It was foreseeable that Russia would exploit Western indecision about Georgia and Ukraine and its de facto veto power in NATO. Putin's warning to Euro-Atlantic security members at the 2007 Munich Security Conference not to grant Georgia and Ukraine Membership Action Plans (MAP) was already a warning signal for further escalation.

By ignoring several warning signs and threats to the European security system, Russian military activities could fundamentally challenge the concept of "Europe as a whole and free". The destabilisation of European security through military aggression against the aspiring NATO country Georgia remained unpunished and almost unnoticed until the much larger events in Ukraine in 2014.

In this way, the Euro-Atlantic security structure gradually eroded. Russia has repeatedly violated the international legal order with impunity. Euro-Atlantic politicians ignored the states that demanded immediate reaction and quick solutions. The Kremlin knows that the next attack on the Euro-Atlantic security architecture will again cause "deep concern" and will not encounter a timely prepared package of policy measures.

Ukraine was the next victim of the Kremlin. Russia separated the Crimea and the Donbas from Europe's largest state and annexed the Crimea through a fake self-determination referendum held after the military invasion under control of the Russian military. Russia thus shattered the Euro-Atlantic security structure and violated the international legal order. The Kremlin's aggression threw Europe back into the Cold War era, when the military gained the upper hand and the borders of European nations were not respected but violently altered.

Despite belated Western sanctions against Russia, it is alarming that international law is being broken, Europe's borders are being reshaped, Abkhazia and South Ossetia are being recognised by Russia as independent states (as Russia calls it the vendetta for recognition of Kosovo) and illegal referendums are being held to seal the status. Sanctions are helpful, but do not prevent Russia from embarking on new military campaigns. The world has just experienced the Russian hackings of the US elections and the considerable interference in US domestic politics along with the poisoning of the Skripal family on British soil.

Worse still, the weak Western response first over Georgia and then over Ukraine resulted in the Syrian crisis where Russia supports an illegitimate dictator to advance its agenda for the Middle East. In exchange for a stronger military presence in the region, the Kremlin used military force against the Syrian people and strengthened the regime of Assad.

Today, ten years after the Georgian-Russian war, four years after the occupation of Ukraine and two years after Russia's interference in the US elections, we should ask ourselves why the Euro-Atlantic security structure is eroding. In other words, we should ask ourselves what went wrong and why the security arrangements that were successful during the Cold War were undermined and how to tackle the Russian hybrid war. Why is the European security architecture not very resilient to the many threats and challenges?

If you look at many arguments before the hacking of the US elections, or during the occupation of Georgia or later Ukraine, it seems that we have turned a blind eye to warning signals of destabilisation of the Euro-Atlantic security structure. We should therefore ask ourselves whether our security architecture is resilient and strong enough to protect us. Furthermore, would we further reduce our security umbrella rather than extend it, given the obstacles and challenges we face? And if the security architecture is at risk, how can we reinvent it?

Alternatively, we should ask ourselves whether Georgia and Ukraine should apply for EU and NATO membership; NATO is, after all, the most important factor for the security of Europe. In addition, we need to rethink how high the carrot of membership of the Euro-Atlantic security system should hang over Georgia and Ukraine; the carrot has been hanging there for almost three decades, as Russia becomes increasingly less democratic and more hostile. Will this carrot be attractive to other future partners?

And whether the dismantling of the international legal order, the hacking of elections and the interference in the domestic politics of other countries, the division of sovereign countries through the recognition of states does not already indicate an erosion of the security order.

The stability of the security architecture should be measured by its ability to identify in time what actually happened and why many warning signals have not changed the course of actions and policies on the ground. We must also ask ourselves when and why we came too late and how we can repair the Euro-Atlantic security architecture.

Finally, it is essential to assess the scale and nature of the erosion of the Euro-Atlantic security structure and to answer the most important question: Why have we failed in a number of cases? As we attempt to address potential threats and challenges and reinvent the nature of globalisation, we are entering the third decade of the 21st century.

Chechnya's Enigma in the Geopolitical Context

Gayane Novikova

Chechens repeatedly appear as militants in numerous conflicts and terrorist attacks. Why is the so-called Chechen threat spreading beyond the borders of the Northern Caucasus?

The Chechen conflict in Russia and with Russia echoes in many areas of the world. We can trace the Chechen fighters in the Nagorniy Karabakh conflict (where for a short period of time Chechen mercenaries were fighting alongside the Afghani mujahideen against the local Armenians), in the Abkhazian conflict (where they supported their Abkhazian kin against the Georgian government), in Afghanistan after the US invasion in 2001, and in the Western Balkans (in Kosovo and Bosnia and Herzegovina). Most recently, they were fighting in Ukraine in support of both the Ukrainian and pro-Russian parties to the conflict: The Chechen "Death battalion" with 300 fighters was supporting the pro-Russian rebels in Donetsk, and the Dzhokhar Dudayev battalion was fighting on the side of the Ukrainian government. Chechens were also among the military leadership of ISIS in Syria and Iraq. Their nom de guerre, al-Shishani ("Chechen" in Arabic), identifies their ethnicity.

Photo: ramzan-kadyrov.ru

The current pro-Russian President of Chechnya, Ramzan Kadirov (left), at the monument dedicated to his father and former President Akhmat Kadirov, who was assassinated by jihadist Chechens. The banner behind the monument reads: "Together we will rebuild our republic without any traces of war."

This article seeks to answer two main questions: Why is the so-called Chechen threat spreading beyond the borders of the North Caucasus? And does the suppressed Chechen insurgency and the return of Chechen fighters from the Middle East pose a security threat to Russia and its neighbouring states?

Author

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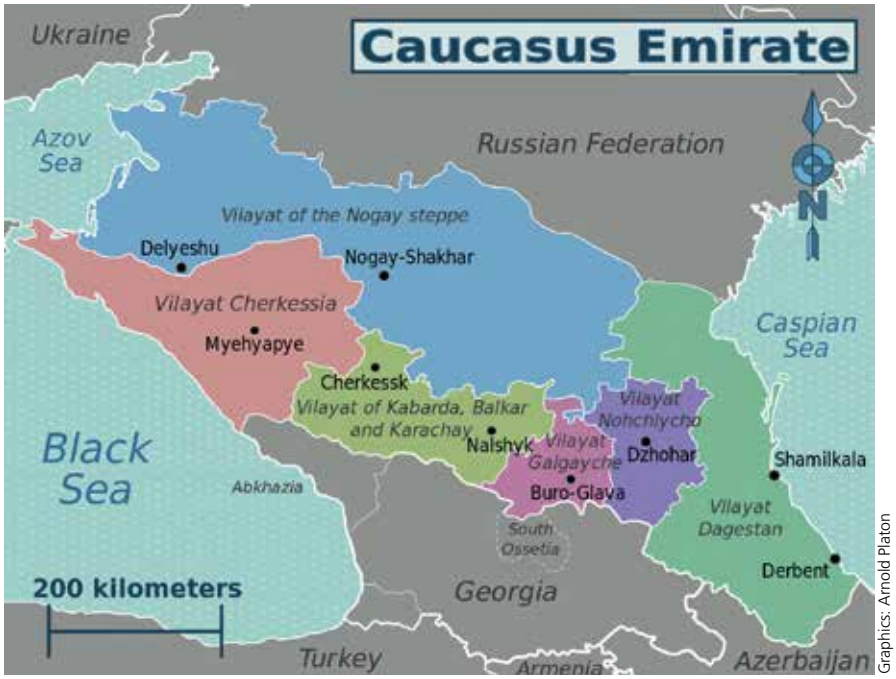
The Initial Stage of Radicalisation in the North Caucasus

Several internal and external factors have greatly contributed to the radicalisation of the North Caucasus. Like the Western Balkans, the North Caucasus is a multi-ethnic, multi-lingual, and poly-confessional region. A combination of these factors as such creates a base for different types of conflict, especially in Chechnya and Dagestan. Moreover, these societies are divided along equally important family/clan and religion lines. In particular, being Muslims, the majority of Chechens have been followers of Sufi Islam mixed with local – the mountain people's – customs and traditions. The other part, starting in the first half of the 19th century, when Imam Shamil unified the Chechens and other nations of the North Caucasus under the banner of Islam, gradually began its journey toward radicalisation. The first Caucasus war (1826-1864) became a strong catalyst in the processes of Islamisation and further radicalisation of the indigenous people of the North Caucasus (with the exception of the Ossetians, the overwhelming majority of whom are Christians). In the course of the last two centuries, there were long and painful periods of open military confrontation between the Russian State – that is, Tsarist Russia, the Soviet Union, and the Russian Federation – and the indigenous people of the North Caucasus, first of all Chechens. The Caucasus Wars were different from other wars. Neither a clearly defined front line nor a single battle predetermined the outcome of any of them. Neither Russian nor Chechen parties to the conflict could claim a total victory followed by a lasting peace.

It is accurate to describe the Russia-North Caucasus interaction as an ongoing insurgency of the people of this region against the Russian State, owing to the fact that this confrontation has spread beyond Chechnya's borders and affects now also Dagestan and Ingushetia. A conflict in broader terms between the Russian state and several nations of the North Caucasus (Chechens, Ingushes, Circassians) is still in place.

From the perspective of the Russian state, it has been a long-standing desire to establish full control over the North Caucasus, in



Graphics: Arnold Platon

The Caucasus Emirate was a Jihadist organisation in Chechnya. Its intention was to expel the Russians from the North Caucasus and to establish an independent Islamic emirate in the region.

general, and over Chechnya, in particular, and to diminish and prevent the spread of the possible security threats into Russia's proper. Russian reforms in the North Caucasus were mainly accompanied by the use of military force.

From the perspective of the nations of the North Caucasus, it is first and foremost a continuity of their fight against the Russian State for the sake of preserving their identity, traditions, and freedom. Their religion, Islam, has gradually become a most important pillar of this battle, although its role in Muslim societies of the North Caucasus is ambivalent. It divided these societies into Islamists fighting a jihad against "infidels" to liberate a "Dar al-Harb" ("a territory of war") and to expand and protect a "Dar al-Islam" ("a territory of peace") and on the other hand into those who reject radical Islam but view religion as a refuge from daily problems. The first group poses a danger to the society itself; the second group to some degree provides a pool of recruits.

Chechnya: Quo Vadis?

Two highly important developments have made reconciliation between the Russian State and, in particular, the Chechen people almost impossible. First, in 1944 the forcible deportation of several nations of the North Caucasus to Central Asia and severe conditions of living caused the death of almost half of all deportees. In exile, their religion – Sufism – became their main identity. The Chechens and Ingushes were gradually allowed to return to their homeland after their rehabilitation in 1957. Relative stability and security in the North Caucasus has been established. However, a new trend became visible in the last years of the Soviet Union, one marked by a growing influence of the Islamic factor in this area. Youth who studied Islam and Islamic law abroad, mainly in Saudi Arabia and the UAE, brought with them a version of Islam that was new to the North Caucasus and began to impose it aggressively at home. In the short period of Chechnya's independence (1991-1994), the division line between the more secular and more religious parts of the population resulted in the existence of two governments almost in parallel: a nationalist and an Islamist.

An open confrontation between the Russian state and Chechnya resulted in two wars (1994–1996 and 1999–2000) on Chechnya's territory and in a number of terrorist attacks that took place not only in the North Caucasus, but also in several Russian cities, including Moscow. The terrorist tactics adopted by the Chechen rebel commanders justified the Russian Government's comprehensive military operation aimed at blocking and destroying the militants in Chechnya. The counterterrorism operation launched by the Russian State which officially lasted from mid-2000 until April 2009 contributed to further significant shifts in security. On the one hand, the horror of these two wars and the implementation of the counterterrorism operation provided fertile ground for further radicalisation of this society. On the other hand, Ramzan Kadirov, who gained President Putin's full support and became President of Chechnya in 2007, began to implement a so-called policy of Chechenisation. It was accompanied by egregious violations of human rights. Internal terror became state policy, carried out by the Kadirovtsy, members of a paramilitary organisation serving as personal guards for President Kadirov, many of whom are former fighters who fought against the Russian state.

Photo: ramzan-kadyrov.ru

Demonstrators in Gudermes, once a hotbed of Chechen separatism, take to the streets in support of pro-Russian President Ramzan Kadirov. The banner reads: "Ramzan Kadirov, we are with you."

The Caucasus Emirate v. the Chechen Republic of Ichkeria

Chechnya was viewed by the Islamists as a "Dar al-Harb" which should be liberated from the "infidels", first of all from Russians. A growing number of Sunni Arab fighters, many of them with direct and close links to the Taliban and al-Qaida, began to penetrate into the North Caucasus as early as the first Russian-Chechen war (1994-96). The newcomers were focused on the purification of Islam in society, which rebelled against the Russian state's reformist project. The Sufi imams were also targeted. The appearance of Arab fighters brought confusion and stimulated further shifts and a struggle for power inside Chechen society: The nationalists lost ground to the Islamists, and the radicals hijacked the nationalist movement of Chechnya.

Photo: ramzan-kadyrov.ru

The Kadirovtsy are a paramilitary organisation which originated as a separatist militia under Akhmad Kadirov and fought against the Russians in the First Chechen War. Kadirov defected to the Russian side in the Second Chechen War in 1999, and the Kadirovtsy began fighting separatists and jihadists. The Kadirovtsy have been accused of numerous human rights violations. They also served in Ukraine and Syria in support of Russian troops.

After the assassination in April 1996 of the first President of the Chechen Republic of Ichkeria, General Dzhokhar Dudaev, who fought for Chechnya to become an independent secular state, the Islamist Zelimkhan Yanderbiyev became the acting President. He declared Chechnya an Islamic state, established sharia as an official legal system, and called for a jihad against the Russian state.

The next step in the further Islamisation of power was the dissolution of the Chechen Republic of Ichkeria and a proclamation of the Caucasus Emirate in October 2007 by then President of Chechnya Doku Umarov. The Emirate included Chechnya, Ingushetia, Dagestan, North Ossetia, Karachai-Cherkessia, and Kabardino-Balkaria. This organisation, whose activities were gradually spreading beyond the geographic borders of the North Caucasus toward Northern Krasnodar Krai and Stavropol Krai (the southernmost regions of the Russian Federation) and into Azerbaijan and the Muslim-populated regions of Georgia, has had strong ties with both the Taliban and al-Qaida.

The secular Chechen government-in-exile, led by Ahmed Zakayev, responded with the following statement: the Chechen state would continue as a parliamentary republic "until free elections could be held in Chechnya."

Although the proclamation of the Caucasus Emirate did not receive much support from Chechen society, it provided to the Russian State the required justification to acquire full control over Chechnya by putting in charge its own "strong man" Ramzan Kadirov. The latter is ruling by blending religious postulates with the harsh punishment of varieties of opponents.

The North Caucasus Fighters in Syria and Russia's Direct Involvement in the Syrian War

Russia's efforts to pacify Chechnya by suppressing both nationalists and Islamists through the policy of Chechenisation resulted in the killing of the regime's opponents and in a gradual relocation of the Chechen militants, together with Jihadist foreign fighters, in Dagestan and Ingushetia in the North Caucasus, and in Georgia and Azerbaijan in the South Caucasus. An announcement of the establishment of a new caliphate in the territories of Iraq and historic Syria, or ISIS, on 29 June 2014 by Abu Bakr al-Baghdadi opened a new opportunity for Chechen militants. In December 2014, the leaders of the Caucasus Emirate pledged their allegiance to ISIS. Several thousand of Islamist militants, who had formally pledged their allegiance to ISIS in mid-June 2015 took transit roots via Georgia and Azerbaijan to Turkey or via Eastern Europe to Turkey and ended up in Syria and Iraq, fighting for ISIS. Presumably, the Russian border control had no intention of stopping them; terrorist activities of the Caucasus Emirate and other militant organisations on Russian territory has been sharply reduced.

One of the critical factors for Russia's direct involvement in the war in Syria should be emphasised: On 25 June 2015, ISIS declared the formation of a new wilayat, or governorate, in Russia's North Caucasus, thereby establishing a territorial claim inside Russia. In this context, Russia could not remain a passive observer: It should support the Assad regime and fight ISIS on Syrian territory, securing its own interests in the Middle East and preventing the spread of the Islamic military threat beyond Syrian borders and a possible return of Chechen fighters to Russia. On 30 September 2015, Russia initiated its military operation in Syria.

According to various official and independent Russian sources, the number of Russian citizens who fought in the ranks of the Islamic state was about 4,000 in 2017. Among them were 1,200 from Dagestan, 100 from Ingushetia, and 175 from Kabardino-Balkaria. Chechens constituted the largest component: around 600 were from Chechnya and another 2,400 from the Chechen diaspora in Europe. The most famous ISIS military commander Omar al-Shishani was Kist, or Georgian Chechen, however the number of Chechen fighters from Georgia was slightly more than 50.

Owing to the long history of the Russian-Chechen confrontation, the return of Chechen fighters even in small numbers to the North Caucasus poses a serious security threat for Russia. These men and women, who have nothing to lose, can greatly contribute to sparking a new round of terrorist activity in this region, which could potentially spread to other parts of Russia. Therefore, the Russian government will fully support the Assad regime in Syria, as well as any other regime that will fight against ISIS.

Conclusion

Two major sets of factors prevent a complete resolution of the Chechnya enigma. The international political and military contexts, Islam as a religion and a political system, the political and military activity of the Islamists, growing Islamophobia in the West, the immigration per se and the differing degrees of adaptation of individuals to new and sometimes quite hostile environments – all these external factors should be considered as the background for all current discussions on radical Islam and its social base.

The North Caucasus will continue to be the most vulnerable part of the Russian Federation. The history of the Chechen insurgency, two Russian-Chechen wars, Russia's counterterrorist operation, and Kadirov's Chechenisation policy are the internal factors that greatly contribute to the radicalisation of certain segments of the North Caucasus societies.

Although the North Caucasus insurgency is suppressed by military means, it is not defeated completely. As Robert Schaefer correctly stated in his book "The Insurgency in Chechnya and the North Caucasus: From Gazavat to Jihad", any insurgency is first and foremost a political struggle aimed to win the support of the population at large through a war of ideas, or legitimacy. In the case of Chechnya, Dagestan, and Ingushetia, we are dealing with a permanent conflict between two reformist projects - the Russian State's secular reformist project and radical Islam as a religious and structural project. Neither can declare victory even in the mid-term perspective. Wide-ranging repressions in Chechnya have pushed the Chechen insurgency into the underground, therefore unavoidably contributing to its further expansion to other parts of the North Caucasus.

The internal societal conflict and the gradually increasing role of radical Islam, the frustration and human rights violations and violence, and strong family connections all stimulate a prolonged exodus of the Chechen population, including former militants, from Chechnya (and Russia) mainly to Europe. According to the different sources, their number is over 100,000. A small number of Chechens have resettled in the US.

For different reasons, these people are not well integrated; most of them live in their ethnically-based parallel societies with internal rules and laws (in particular, in Germany, Chechen gangs terrorise fellow Chechens through a so-called Sharia police). The very low level of integration generates anger against the host countries and frustration with "unfriendly" societies, thereby turning them into easy prey for recruiters from different Jihadist organisations. The most vulnerable people can be provoked to take extreme actions. The Boston Marathon bombing in April 2011 executed by the Tsarnayev brothers is the most vivid example. The significant number of diaspora Chechens who fought and still fight in the Middle East is further evidence of the existence of an environment that breeds further radicalisation.

Another piece of the Chechnya puzzle should also be mentioned in a global terrorism context: The number of people who will carry out their protests in the form of terrorist attacks - and more and more often individually as "lone wolves" – will grow. Terrorist organisations will take responsibility for all these attacks, not least to attract more supporters. To fight against this type of protest is almost impossible.

P.S. This article was already submitted when, on August 20, 2018, there were several attacks against the Chechen military in the capital of Chechnya - Grozniy - and in the Shali region. The ISIS claimed responsibility for these attacks. ■

Land Combat System Support at the NATO Support and Procurement Agency (NSPA)

Jörn Brauer and Robert Elvish

This year NSPA is celebrating its 60-year anniversary! Today, NSPA is a key logistics enabler for the support of both NATO and nationally owned military equipment as well as managing contractor support to operations on behalf of the NATO Commands, multinational groups and individual nations.

The Agency is headquartered in Luxembourg and has programmes based in France, Hungary and Italy with outstations in Afghanistan, Kosovo and other locations. Today, NSPA's establishment encompasses more than 1,350 positions, with 60 of these personnel deployed on operations. NSPA business activity has grown nearly fivefold in the last decade and now includes the acquisition role. Business and workforce growth is predicted to continue, with customer nations directly funding more than 90 percent of these activities; less than 10 percent comes from NATO common funding.

The rapid growth of the Agency, political and operational developments and the need to develop the acquisition role led to a comprehensive review and refresh of the Agency's five-year Strategic Direction in 2017 and led to an optimised organisational structure that is now composed of four main business units:

- Life Cycle Management
- Support to Operations
- Central Europe Pipeline System
- NATO Airlift Management

These are underpinned by four key support functions: Procurement, Finance, Human Resources and Information Technology. These are essential to ensure the smooth running and management of the supporting processes.

NSPA's core business continues to be the life cycle management of equipment and weapon systems. Through the development of the acquisition role, the Agency now oversees activities in all phases (from concept phase through acquisition and in-service to disposal) of the system life cycle, providing customers with 'cradle-to-grave' support. NSPA currently manages 30 multinational Support Partnerships (SPs) covering over 90 major weapon systems.

The strength and attractiveness of the Agency is largely due to the wide range of experience and capability within the business units and the electronic logistics solutions available, which are developed and exploited to the fullest extent possible. The Agency has a proven record of timely and cost-effective delivery, high levels of transparency and customer satisfaction and creating economies of scale for customer nations, particularly in the very successful multinational SP mechanisms. The Agency also has the capability to access a broad supplier base of more than 10,000 companies using a range of innovative procurement mechanisms. It has a professional Agency workforce and attractive multinational legal frameworks, as well as an integrated suite of IT solutions and the ability to access transatlantic capability platforms through the NATO structure.

Authors

Jörn Brauer, Staff Officer Life Cycle Management Directorate, NSPA and **Robert Elvish**, Programme Manager Air and Land Combat System Programme Office, NSPA.

Photos/Graphic: NSPA

The mid-life upgrade of MLRS extended the capabilities and service life of the system.

Land Combat System Support

NSPA's support to Land Combat Systems is a perfect example illustrating the range and depth of support provided to NATO and Partner Nations. Most support in this domain is provided through the NSPA Air and Land Combat System Programme, it provides full life cycle support to a range of weapon systems with roughly 200 highly skilled engineers, technicians, logisticians and specialised procurement and finance staff.

The foundation of multinational cooperation and consolidation of requirements is the SP structure structure unique to NSPA. The SP concept brings together NATO and partner nations with common requirements, areas of mutual exchange interest in support of fleets, systems and services. Nations provide governance and guidance, whereas the Agency manages the support requested by the nations. This concept has proven its effectiveness for 60 years now.

Supported systems in the Land Combat System domain include missile systems such as TOW/ITAS, SPIKE, STINGER; artillery systems like the MLRS and PzH 2000; armoured vehicles including the LEOPARD, DINGO Light Armored Vehicle (LAV) and BOXER. The SPs are able to consolidate national requirements, resulting in economies of scale. NSPA provides competitive international bidding, ensuring the lowest cost, best value and a centralised point of contact for customer and industry engagement.

Scope of Support

The scope of life cycle management support for land combat systems includes acquisition, engineering, contract management, maintenance & overhaul and warehouse management. Support is provided primarily through contracts with industry, established through a streamlined international competitive bidding process. NSPA also maintains a highly capable workshop facility able to provide a range of direct services to nations including repair, maintenance and modification of mechanical and electro-optical systems. The United States' Foreign Military Sales (FMS) are another area in which NSPA has significant expertise and through which it is able to provide support to the partnerships and individual nations.

The latest major acquisition project is a fleet of Light Tactical Armoured Vehicles in multiple configurations. This fleet will consist of more than 100 vehicles. Deliveries are expected to begin in 2019 and to be complete within two years. The Agency has applied a rigorous project management approach to this undertaking ensuring that the customer nation is getting the best value while meeting their requirements on time.

Engineering changes, obsolescence management and mid-life upgrades are an essential part of the Land Combat Systems efforts. The rebuilding of the PzH 2000 Fire Control System is an example of the work undertaken in NSPA's own workshop facility. Likewise, the manufacture of TOW/ITAS Traversing Units demonstrates the broad range of capability available. Mid-life upgrades include improvements to the MLRS, such as the integration of a new fire control system and GPS as well as the vehicle drivetrain and turret motor upgrades. The Agency also runs a Service Life Extension Programme for the STINGER missile systems. This initiative will see the replacement of multiple time-expired components, such as the rocket motor and energetic material, leading to a substantial increase in the service life of this weapon system.

Examples

In the Land Combat System domain, the Agency is also providing Logistics and Engineering Support to Unmanned Aerial System (UAS) users. The UAS SP was established in 2014 and is currently providing logistic solutions for a variety of UAS systems such as RAVEN, ORBITER, WASP, FlyEye, BLACK HORNET, SEARCHER MK III, SCAN EAGLE and HUGINN.

Despite the differences in class and size of these systems, NSPA adopted a unique business model aiming to provide logistic support services integrated with configuration management to comply with the National Airworthiness regulatory frameworks. Under the existing logistic support contracts, NSPA is currently running several upgrade programmes triggered by new capability requirements and by the necessity to align the delivered systems on a unique supportable configuration.

The BOXER multi-role armoured vehicle is another example of support provided within the Land Combat Vehicle SP. It is being supported by NSPA in cooperation with the procurement agency OCCAR (Organisation Conjointe de Coopération en matière d'ARmement/Organisation for Joint Armament Cooperation) ensuring an efficient cooperation from production to in-service support. Support services for the BOXER include Configuration Management, Interactive Electronic Technical Documentation, Logistics Support Analysis, Technical Data Package management, common stock management and provision of spare parts. In addition, NSPA has contracts and outline agreements in place for industry support services. SP nations are currently Germany and the Netherlands, while future BOXER nations may join the Support Partnership to take advantage of the many benefits provided through NSPA.

Outlook

The Agency's recent exponential business growth is a clear indicator of its success, building on the outstanding levels of services delivered and high rates of customer satisfaction. ■

Left: Manufacturing the TOW/ITAS traversing units demonstrates NSPA's broad range of capabilities. Right: Comprehensive support is granted for the increasingly internationally used MRAV BOXER.

"High Range of Capabilities to Support NATO and the EU"

Interview with Brigadier General Rudolf Maus, Director of Life Cycle Management of the NATO Support and Procurement Agency (NSPA)

Foto: NSPA

ESD: What led to the recent restructuring of NSPA by building two new directorates out of your previous area of responsibility, one for Support to Operations and one for Life Cycle Management?

Maus: Until the end of 2017, I was responsible for all operational capabilities of the NSPA in both domains, the support for operations as well as the Life Cycle Management, which represents a very wide spectrum of different capability portfolios. The Agency is facing a continuous rapid business growth in all areas, including an increase in the new acquisition role.

To give you an indication, NSPA business activity has grown nearly fivefold in the last 10 years and reached more than four billion Euros in 2017. Within the growing business portfolio, we also had to focus on the further development of the systems acquisition capability and the management of the exponentially expanding Life Cycle Management activities.

Beside this, it was necessary to concentrate all resources to support NATO and the nation's missions. Due to the changing geopolitical situation, the Agency has to be ready to support NATO's current and future missions, which also cover European areas of interest.

Mainly this growth in portfolio, scope and variety led to the restructuring to maintain a manageable span of control and a focused customer engagement at senior management level as a vital element to achieve customer satisfaction.

ESD: Focusing on the continuous growth of the NSPA, what do you see as major success factors from the customers' point of view?

Maus: The Agency's recent exponential business growth is a clear indicator of its success to achieve a high degree of customer satisfaction in delivering projects and services in a responsive and transparent way within scope, time, budget and at high quality.

The Agency is offering a proven platform for multinational cooperation and with that the ability to consolidate national requirements, to contribute to interoperability, to provide the know-how and experience exchange amongst nations. This often leads to new initiatives and to achieving collective solutions with the advantage of building capabilities together, which one nation alone could not achieve. Economies of scale – but also a high degree of efficiency – come with it. In particular, in areas where resources are scarce, a collective approach also avoids unnecessary competition between allies, an effect we all know, for example, in the operational environment where reacting markets often create extra burdens.

A further advantage represents the very successful mechanism of a very direct and effective governance model exercised by the nations in currently 30 established multinational Support Partnerships. Member nations who decide to follow common goals and achieve defined products and services build the legal framework in which they decide on – amongst other characteristics – the required goal, scope, budget and work force and approve the desired outcome. This mechanism keeps our governance fully committed to the programme and focused on a successful outcome.

Finally, making use of NSPA's capabilities means using a highly skilled and very experienced work force in a very wide capability spectrum; this can help to avoid "reinventing the wheel", closing national expertise or resource gaps or freeing up national resources, which then can be reallocated to other national priorities.

Therefore, from this perspective, we see ourselves not only as an executing agent for collective solutions, but also as an alternative to national initiatives under national responsibility.

ESD: Acquisition of military systems has become a new area of responsibility for NSPA – what has changed or will change?

Maus: The NATO Council allocated the Acquisition role to NSPA in 2015. Although this task was not new to NSPA (we ran acquisition projects already in the Armoured Vehicles, Helicopter, Unmanned Aerial Systems, Deployable Camps and Ground Based Defence domains), the Agency took further initiatives to strengthen this capability.

As I mentioned before, we optimised our organisational structure by establishing a new Directorate responsible for "cradle to grave" Life Cycle Management. The Directorate of Life Cycle Management is covering all Acquisition activities from concept phase to the fielding as well as In-Service Support and – later in the life cycle – upgrading of systems, as well as Disposal, Dismantling and Demilitarisation, which in our view is also a growing domain. Currently, we do support more than 90 weapon systems in different phases of their life cycle.

This includes responsibility allocated to us in 2017 of the project management for the concept phase of the "Alliance Future Surveillance and Control (AFSC)", which can be seen as a first example in the major acquisition domain.

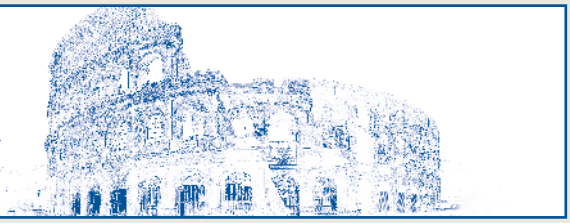
This new organisation has been operational since 1 January this year.

Next to this, we introduced an Acquisition Planning & Development Office in my staff, which provides us with the very important capability to cover the very early pre-project acquisition phase. As NSPA's point of contact for future acquisition initiatives, this team of acquisition experts will, in a close dialogue with the customer nations, ensure the development of an initial business case including project plan, life cycle cost and risk

analysis. It is designed to ensure a professional project and Integrated Project Team set-up, following the vital principle: "Get it right from the beginning!" This team will also help to continuously improve the acquisition processes and execution in the Agency.
From this perspective, NSPA also took initiatives to further enhance our fully integrated Project Management tool, which also allows us to build up IPTs by embedding national representatives as IPT members with real-time direct access into our Project Management system. This opens a completely new way of interacting with our customers remotely and across borders. One example is a series of projects, which we are conducting for a nation, in which the Project Manager function is filled in by an MOD member and executed from the home base in that country. This is just one example of further innovation we are looking at, and there will be many more possibilities in the future.

ESD: The last question is about your view regarding NSPA's support opportunities in capability development and sustainment towards European Union member nations. Is this an area that NSPA can manage?
Maus: In July 2016, the joint NATO-EU declaration was signed with the intent to increase the cooperation between the two entities, to avoid duplication and to spend money wisely to gain a maximum of capabilities.
We see today a strong drive in the community of the European nations, based on EU investment funds, PESCO and capability requirements like described in the initiative on military mobility as well as in operational environments. I do see many cooperation opportunities with the EU nations in the armaments, procurement and logistics capability domains, but I also see a risk of duplicating already existing, established, proven and well-performing capabilities. From my perspective, this should be avoided to the benefit of the nations, as it will reduce inefficient money spending.
Building on existing complementarity, synergy and strengths should be the way forward. NSPA would like to be seen as an option in this domain. As I explained earlier, the customer base of the Agency, including our partner nations, already encompasses all EU nations. We are very experienced in the set-up, execution and implementation of collective solutions.
There are already several successful examples of support provided to and cooperation with EU nations. For instance the NATO-owned MRTT programme, which is based on a European initiative and executed in cooperation with OCCAR, the build-up/operation and maintenance of a fully equipped hospital for the deployed troops in Kosovo, the logistics support to sustain EU Battle Group deployments, the naval fleet support in Mediterranean Sea operations, logistics support in operational theatres like Iraq and Mali, as well as a variety of support to nearly all individual nations.
From this perspective, I also would like to highlight the very good and successful cooperation established with OCCAR in programmes like the MRTT, BOXER, A400M, TIGER Helicopter and Cobra.

The interview was conducted by Gerhard Heiming.



Viewpoint from Rome

What is Italy's New Coalition Government's Position on Defence Policy?

Luca Peruzzi

The first few months have been extremely busy for the new Italian Defence Minister Elisabetta Trenta, appointed by the coalition government formed in June with the League Party and the Five Star movement. Trenta has shown immediate international commitment, support for national defence and protection of strategic interests. The new defence minister, formerly senior programme manager for development, economy and international cooperation with expertise in post-conflict scenarios and a consultant to the Italian Armed Forces and a captain of the Italian Army Reserve, provided the guidelines for her five-year assignment during the parliamentary hearing before the Joint Committee of the Chamber of Deputies and Senate on 26 July.

Two keywords in the agreement signed by both parties to the coalition government characterize her view on the defence sector: resilience and dual use. "Resilience is the ability to adapt to change, especially in the face of the complex hybrid threats facing our country," she said. "Dual use, on the other hand, means the awareness that we must support, and at the same time broaden, the dual use opportunities for the defence capabilities for non-military use, to support resilience".

Elisabetta Trenta hopesthat defence will become part of a collective security concept shared by other ministries, institutions and industry. According to the new minister, the planning and implementation of a "national strategic system" should improve "collective security" and "national resilience". The development of the system should be based on cooperation between various ministries, industry, science, research and the private sector.

"NATO is the reference organisation ensuring an adequate security framework for the entire Euro-Atlantic area and practising deterrence and defence against all threats," said the minister,stressing Italy's strong contribution to various initiatives within and outside the Alliance. "Italy will continue to promote all initiatives to strengthen the Alliance in the Mediterranean and the Middle East", as proposed at the NATO Summit in Brussels from 11 to 12 July and by the Italian Defence Minister and the Italian Foreign Minister. "For us, fundamental things such as the "southern flank" and the "defence budget" are our arguments and the reasons on which they are based have generally been shared (by the allies)," said Minister Trenta. With regard to burden-sharing she said: "We want national investments to ensure resilience – especially in the cyber and space sectors – to be counted towards the 2% of GDP that countries have pledged for defence spending", that is, investments that affect both the military and civilian sectors, also thanks to the "multipurpose on design" assets.

In addition to strengthening the South Hub as part of the NATO Command Structure Reform, Italy has requested that the Joint Force Command (JFC) Naples be given the same importance and role as the JFC Brunssum. This demand has been granted to Italy. "The cyber threat is a risk factor for the country, but also a major investment opportunity that can increase our defence and security level," she stressed. A number of acquisition programmes have been launched, "but it is necessary to continue investing in this sector", especially with regard to the newly created Joint Command for Cyber Operations (CIOC). "We need to review spending to reduce waste while further developing the concept

Photo: Italian MoD

Elisabetta Trenta, the new Italian defence minister.

of the multi-purpose use of military capabilities to contribute to collective defence. As part of this unified and systematic vision, "we must create centres of excellence with a high degree of specialisation, made up of universities, research centres and industry, including the main companies and SMEs," she proposed. These centres must promote technology transfer and innovation by setting up a monitoring and support centre within the ministry to help industry develop international markets.

With regard to the F-35 programme, which the Five Star movement, which is close to the minister of defence and which supported her in her candidacy, has always rejected, Trenta said: "I asked the technical offices and competent authorities for an in-depth evaluation that takes into account the needs of our armed forces, related occupational issues, and potential business repercussions and other important variables to draft a comprehensive reflection on the issue." More recently, when interviewed by Corriere della Sera newspaper, she said that "as soon as we complete the technical analysis, we will report in a transparent mode, but I can anticipate we are working towards a (procurement) reduction, in accordance with what we previously said."

Italian defence needs funding for future national and European programmes, such as the forthcoming development of the Eurofighter TYPHOON programme, which is crucial to the maintenance of the European aerospace and military industry. The recent announcement that the new generation of the British TEMPEST air combat platform will be launched at the Farnborough Air Show, with Leonardo UK playing a key role, requires Italy to take a decision on the future of its aerial platforms if Italy is to maintain a defence aerospace industry alongside a naval one with Fincantieri and the weapons systems programmes with MBDA.

The new minister will also promote smart, autonomous power grids for military facilities and the use of polygons and training areas, the latter "with strict respect for the environment and for the use of the territory as a research infrastructure, for experiments and for testing multipurpose/dual technologies in cooperation with universities, research institutes, industry and local authorities", the minister added.

The protection of military and civilian personnel is at the top of the new minister of defence's list of priorities. In accordance with the principles of our (coalition) programme, I will work to ensure that the legitimate expectations of our men and women, whether in uniform or civilian, are met," she said, including family-related support measures and a law on military unions.

Reaffirming current and future support for NATO and the EU, the new minister explained Italy's bridging position between NATO and Russia in a parliamentary hearing. She does not see Russia as a threat and does not want to participate in the European intervention initiative and called for a reassessment of international missions. Given the crisis beyond the Mediterranean and considerations of security and stability in Italy and Europe, "the Italian military will continue to carry out missions that the current government considers vital to the preservation of national interests," she said, "but I would like to highlight the contextual decisions reaffirmed in the Intergovernmental Treaty: security, thoughtful decisions on the use of resources, and whether these missions are actually in the national interest. Afghanistan, for example, is one of those missions whose quota needs to be revised quantitatively by coordinating changes with allies."

As it was for the previous government, the Mediterranean is at the centre of national interests, and the first political gesture of the new coalition government was the donation of 10 patrol boats

Photo: Luca Peruzzi

On 17 July 2018, Minister Trenta announced the new International Flying School (IFTS) at Lecce-Galatina Airport, a public–private partnership between the Italian Air Force and Leonardo.

and ships to Libya with a training and support package to assist the Libyan coastguard and the Interior Minister of the local navy in their efforts against illegal trafficking and SAR operations. Although Italian support for Libya has in the recent past significantly reduced migrant flows, security problems such as the confirmed influx of jihadists into Italy and Europe and the reluctance of other EU countries to distribute migrants are the reason why the new coalition government wants to introduce mechanisms for the relocation of migrants to other EU countries in order to alleviate the burden on Italy. At the recent informal meeting of EU defence ministers (29-30 August), the Italian defence minister proposed a review of the EU mission EUNAVFORMED Sophia by proposing a rotation of disembarkation ports instead of exclusively Italian ports, linked to the subsequent resettlement of migrants to EU Member States. The proposal was rejected and tensions between Italy and the EU remain very high.

The new Libyan crisis is not only a setback for Italian and international stabilisation plans in the area, but also threatens Libyan coastal protection and creates a new potential return of migrants to Italy with possible tensions in Italy and ultimately for the EU. The Italian Government has rejected any plan to send special units to support the Libyan GNA, but Italy has a military mission to provide medical, humanitarian and logistical support to the local authorities at the Misurata and Tripoli naval bases, which would need to be evacuated in addition to Italy's diplomatic staff and Italian employees as the Libyan crisis unfolds.

The Evolution of Italian Special Operations Forces

Paolo Valpolini

In the last few years, the Special Forces have undergone far-reaching transformations which aim to increase their capability profile, efficiency, effectiveness and size.

Until July 2006, the Italian Special Forces (SF) were under national command. In Bosnia-Herzegovina, for example, the Italian SF units operated directly under the Italian Contingent commander and were not part of the multinational SF organisation of NATO IFOR/SFOR. This was because the Italian military was based on conscription; the first brigade of volunteer soldiers was established in 1996 at a time when the situation was getting worse and the Special Forces were the only units consisting of professional soldiers. And even when professionalisation became a reality, it took some time to change the mentality and use the SF in their actual role. In July 2006, Italy made an SF unit available to ISAF, the International Security Assistance Force for Afghanistan. Known as Task Force 45, the unit was secretly deployed; its existence only became known to the public a a few months later.

Photos: P. Valpolini

An LMV LINCE of the 9th "Col Moschin" Regiment near Farah, Afghanistan. In 2006, Italy deployed its "Task Force 45" to that area, for the first time putting its SF under NATO command.

A New Structure

The transformation between the mid-1990s and the early 2000s triggered by the 25/1997 law on the Reorganisation of Military High Commands enabled the Italian military to take this step. Before 1997, the Chief of Defence (ChoD) was on an equal footing with the heads of the three services; the law of 25 January 1997 made him – the only four-star general in Italy – the real chief, as his colleagues were three-star generals. Until 1997, each service had its own SF, with a chain of command that went up to the service chief. The SF unit of the army, the 9th Regiment "Col Moschin", was part of the "Folgore" Airborne Brigade, which made C2 even more difficult, while the Gruppo Operativo Incursori of the navy was part of COMSUBIN, the raiders and divers command, which reported directly to the Navy Chief. Until the beginning of 2000 the air force had no SF unit. As far as the Carabinieri are concerned, GIS (Gruppo d'Intervento Speciale, Special Intervention Group) was regarded as an HRT unit of the police, which was mainly concerned with homeland operations.

The reorganisation of 1997 led to a profound change as the services now deployed the armed forces through a Joint Operational Command HQ known as COI (Comando Operativo di vertice Interforze), which reached its FOC on 1 November 1999. The COI was in charge of all conventional joint operations. However, an SF-dedicated C2 structure was missing, which was created in the early 2000s and became operational on 1 December 2004. Known as COFS (Comando interforze per le Operazioni delle Forze Speciali), the Joint Special Forces Operations HQ was the equivalent of the COI for special operations, the services remaining the force providers, while the COFS would employ SF in operations.COFS is thus responsible for the planning and execution of special operations as well as for SOF joint training and force integration prior to deployment. COFS also advises the ChoD on matters related to special operations.

Compared to the COI, COFS has some peculiarities: first of all, it is responsible for selecting and acquiring the equipment used by the whole SF community in operations, aiming at promoting and optimising interoperability. This process is either top down or bottom up, as each SF unit maintains an R&D section. COFS has a final say on procurement, as it finances the projects. For high-cost programmes (such as helicopters), the Defence General Staff provides the funds. But probably the most important fact is that the COFS has been certified twice by NATO as capable to set up a Special Operations Component Command (SOCC), under which different SOTGs (Special Operations Task Groups) can operate downrange.

Author

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A Peculiar Solution

Numerous units were operating under COFS, as Italy adopted a peculiar solution, the Special Operations Forces category including SF units as well as those that would be defined elsewhere as SF Support Groups. The four SF units, the so-called Tier 1 units, were capable of executing all the three core tasks as defined by NATO, that is, Special Reconnaissance (SR), Direct Action (DA) and Military Assistance (MA). The army provided the 9th "Col Moschin" Regiment, the navy the GOI (Gruppo Operativo Incursori), the air force the 17th Wing, and the Carabinieri the GIS (Gruppo Intervento Speciale). While all have some overlapping capabilities, the army element is more associated with land operations and HALO/HAHO infiltration, the navy element is the relevant element for maritime operations, the air force unit is specialised as a combat controller and JTAC, while the bread and butter business of GIS is hostage rescue. Some overlapping skills are necessary, because – in view of the limited number of personnel – staff attrition resulting from a high op-tempo and long-lasting assignments can be reduced. However, COFS aims to avoid the duplication of work in order to save on scarce resources.

Besides Tier 1 units, there are two Tier 2 units, both provided by the army the 4th Alpini Parachute Regiment is equivalent to the US Rangers and is in charge of DA and MA missions, while the 185th Target Acquisition Regiment (185th RAO) deals with SR and MA.

Enablers for Special Forces

Special Forces need enablers in order to deal with complex operations. Previously, most of these enablers were not dedicated, which can cause availability problems in case of need. The COFS could count on K9, EOD and Electronic Warfare assets, provided by the services, with a dedicated Psyops element having been formed as part of the 28th Regiment. As for air assets, the army created the 3rd Special Operations Helicopter Regiment with CH-47F and NH-90 aircraft; this was to become part of the Army SF Command, but this has not materialised as of yet. As for the air force, the 15th Wing AW101 CSAR helicopters are definitely assets that might well operate in support of SF, as well as the AB212s of the 9th Wing. Air transport aircraft, of the C-130J HERCULES and C-27J SPARTAN variety, belonging to the 46th Air Transport Brigade, often operate in support of special operations, but for the time being no specially trained crew is earmarked for this task.

Signals are a key element for SF. Under the new structure, one company from the 11th Signal Regiment will be dedicated to SF support.

Tier 1 and Tier 2 Units

In late April 2018, the Italian ChoD signed the "Directive for Strengthening the Special Operations Compartment", a keystone document that is generating a considerable transformation in the Italian special operations compartment. Tier 1 units add new tasks to SR, DA and MA, acquiring the so-called full-spectrum "plus": these are Hostage Release Operations (HRO) and Strategic Reconnaissance, the latter being a multiagency effort. Besides downrange operations, Tier 1 units are also called to support counter-terror operations on national territory, adding their capabilities to those of Police Special Units. In late 1977, the 9th Regiment and the GOI received an antiterrorism role in response to a request of the then European Community that asked all member nations to form special intervention units, and UNIS being its Italian version similar to the German GSG 9. Next to the two military units, the Carabinieri, at that time part of the army,formed the GIS receiving personnel from the 1st "Tuscania" Carabinieri Paratroopers battalion, at that time part of the "Folgore" Airborne Brigade. The GIS always maintained that role, but for the army and navy SF units the homeland security role is a comeback, while for the 17th Wing homeland security it is a new thing, as the unit was created in the mid 1990s and thus never experienced the 1970–80s terrorist era.

The Tier 2 units will need the capability to execute the three core tasks, SR, DA and MA. Thus, the 185th RAO must add a DA capacity, although target illumination is considered a direct action, the aim of the COFS being to increase the regiment capabilities to make it the equivalent of the French Army 13ème Régiment de Dragons Parachutistes (13ème RDP), even though SR will remain its core business. As for the Ranger Regiment, this should become the equivalent of the US 75th Ranger Regiment, whose main task will remain DA. However, when setting up a mission, the regiment is already autonomous in terms of target reconnaissance and acquisition and it can also acquire targets for a third party. Having acquired the capability to cope with all three missions, Tier 2 units acquired the full SF status de facto, and thus they can now be used in that role also in NATO missions. In fact, the Italian Special Operations Task Group provided to NATO for the NRF18 contingency is frameworked on the 185th Regiment, augmented by 4th Regiment staff elements and a Special Operations Task Unit. The new organisation will see the creation of Tier 3 units, whose tasks will be Military Assistance and DA or SR. The aim is to enlarge the number of personnel while avoiding duplication.

A member of the 4th Alpini Parachute Regiment. The Italian Army Ranger unit has become a full SF unit as it now covers all three SF core tasks: SR, DA and MA.

A Further Insight:

José María Fajardo

Interview with José María Fajardo, Mortar Systems Product Manager at EXPAL

ESD: What kind of business record does EXPAL have with the Italian Armed Forces?

Fajardo: Italy is one of the most important NATO allies in Europe with well-prepared, modern and advanced armed forces that are present in many international missions. Italy also has a strong and mature defence industry which contributes to the strength of the armed forces.

For EXPAL, Italy is a Tier 1 customer on whom considerable efforts and capabilities are concentrated to meet the needs of the armed forces directly or in cooperation with local partners.

EXPAL develops its activities in Italy in different ways:

EXPAL owns the local EXPAL UEE Italia plant in Aulla (Tuscany, Italy), which is mainly dedicated to the demilitarisation of ammunition and the final assembly of defence material.

As an industrial partner with other local companies such as Leonardo, Simmel Difesa, MES or Fiocchi, EXPAL contributes to various programmes for the army.

EXPAL is a direct supplier to the armed forces for several contracts, such as the procurement of naval ammunition for the Italian Navy, demilitarisation contracts for the MoD or new advanced artillery programmes and value-added services for mortar systems under development.

With regard to mortar systems, EXPAL supplies Italy with 81mm capability covering all operational requirements, with high-performance products, high quality standards and other stringent requirements of a first-level army such as the Italian, which leads international coalitions in missions in various scenarios around the world.

The 81-MX2-KM mortar system, the 81mm HE, SMK, ILLUM & TP mortar ammunition as well as the TECHFIRE Firing Control System – all these products developed and manufactured by EXPAL have been supplied to the Italian Army since 2011. Since then, EXPAL has assisted the army with maintenance and technical advice on the material supplied.

The high technological level of EXPAL products and their quality standards, as well as the confidence of the Italian Armed Forces in EXPAL, and also of other European armed forces that have launched mortar tenders in the last years, have contributed to consolidating EXPAL as a European reference supplier of mortar systems.

ESD: The Special Forces in particular are striving to continuously improve mobility. How can you as a manufacturer of mortar systems support these efforts?

Fajardo: Mobility is undoubtedly the most important requirement of mortar users in modern combat contexts, given the constant development of detection and location equipment for the enemy fire position.

However, mobility alone is not enough; it must be accompanied by the capability to react by fast entry into and exit from the shooting position, so that the use of force takes place with greater agility and efficiency. Mobility and responsiveness are therefore an obligation and the trend to which most EXPAL developments are geared.

EXPAL works on all these concepts and takes care of all tasks that the user has to take on from reaching the firing position to leaving the firing position: Displacement – Entry in fire position – Aim – Fire – Corrections – Fire for effect – Exit of position – Displacement.

In understanding responsiveness in the broadest sense, displacements are only one aspect to consider, but it is necessary to find solutions for all other tasks. The broader concept developed by EXPAL is EIMOS, as it deals with each of the tasks mentioned above.

The mortar integrated in the vehicle allows the user a high degree of mobility, which is even higher if the vehicle is lighter and more agile. In this sense, the EIMOS developed by EXPAL for 60 and 81mm can be integrated into a lightweight 4x4 platform and can absorb recoil at maximum load without impairing the vehicle.

Taking position is as simple as stopping the vehicle, and aiming is done automatically thanks to the Inertial Navigation Unit integrated in TECHFIRE, EXPAL's Firing Control System, which allows the operator to fire on the target in less than 20 seconds.

As soon as the data from the forward observer have been received, the corrections are communicated via TECHFIRE if necessary and, after having been approved by the commander, the weapon is automatically re-aiming to fire for effect from the second round on.

The speed of taking up and leaving the firing position, as well as accuracy and precision, are the main features of the mortars to which EXPAL is dedicated.

The use of light tactical transport vehicles, such as the 120mm mortar, which enables the mortar to be deployed in less than 2 minutes using a hydraulic system, or the improvement in ergonomics during operative transport of 81mm or 60mm are clear examples of EXPAL progress in this respect.

Similarly, the use of inertial systems or electronic aiming systems with north-finder capability in GPS-denied environments in conjunction with the Fire Control System facilitate the task of taking aim, which reduces the time spent with the traditional system based on the use of aiming posts and goniometres.

Accuracy is also a key element in reducing the time needed for aiming corrections. EXPAL has carried out several initiatives in this context by introducing elements that limit random errors and help to reduce systematic errors during firing.

EXPAL is also working on improving the accuracy of mortar ammunition by developing new guidance systems that contribute to improving reactivity and make it possible to achieve effect from the first round on.

The interview was conducted by Waldemar Geiger.

The SOF Community

To become part of the SOF community, these units will have to fulfil a number of requirements, namely, being at least at company level and having an adequate mission statement, their mission having been approved by the ChoD. They will undergo an evaluation process before being certified. At least three existing units should apply for SOF status, although probably only with part of their force, considering other commitments. The 1st "Tuscania" Carabinieri Parachute Regiment is an elite unit from which the GIS personnel is selected, making it inherently apt to support the GIS in its HRO role and able to act as light infantry unit. Last but not least, it can carry out MA missions, especially towards police units in difficult environments.

The navy is ready to provide a company-size element taken from its "San Marco" Brigade, the core element of the Italian joint amphibious capability. As a company dedicated to operating with special tactics in riverine and maritime environments and able to conduct recce missions prior to landings, it is part of the Brigade and should be the one earmarked for the SOF role.

As for the air force, the 16th Force Protection wing set up in 2000 has been operating downrange for over a decade: a company known as STOS (Supporto Tattico alle Operazioni Speciali, Tactical Support to Special Operations) has been formed, and this should be the one earmarked to operate under COFS' command as a Tier 3 light infantry unit, with the main role being support to the 17th Wing, especially for Personnel Recovery/CSAR type operations.

One of the new CH-47F CHINOOKs procured by Army Aviation; four dedicated aircraft should be delivered to the 3rd Army Aviation Regiment, which should soon be transferred under COFS control.

Dedicated Elements

The other major step forward for the new organisation is that enablers will be dedicated elements. Rotary wing assets are key to SF operations. A working group has been formed at COFS to establish a specific training syllabus for aircrews dedicated to SF support. Each service, with the exception of the Carabinieri, will provide flying assets and a dedicated crew. The army's 3rd "Aldebaran" Regiment should in due course receive four CH-47F aircraft with the extended range kit; this option for those aircraft should be among the top priorities among joint programmes. The navy will provide the EH-101 from the REA, the heli-assault unit based at Luni, La Spezia, close to the GOI. As for the air force, the 15th Wing is the one earmarked to support SF, its AW101 helicopters being apt to fulfil their requirements, which are close to those of the CSAR. How long it will take to form a joint SF helicopter unit cannot be predicted.

The SF component of the Italian Navy's "San Marco" Brigade will become a SOF element and will thus fall under COFS as a Tier 3 unit.

Having dedicated helicopters is important, but to effectively employ them in operation requires a dedicated C2 element within COFS itself and even more so in a SOCC HQ, the latter being deployable by definition. The COFS organisation will thus receive another Assistant Chief of Staff (ACOS): to the current three, ACOS OPS (Operations), ACOS AII (Training, Innovation and Interoperability), and ACOS LOG (Logistics) a fourth one, ACOS AIR, is being added, whose subordinated personnel would provide the core of a SOAC (Special Operations Air Command) within the SOCC, with C2 duties towards two or more SOATG (Special Operations Air Task Groups).

No information was given on fixed wing air support. To provide adequate support to SF, transport aircraft aircrew should also be specifically trained. Moreover, a gunship module to be installed on the C-27J was developed; however, no contract has yet been placed for such a system, which would include also some upgrades to the aircraft in terms of optronic sensors. When it comes to other types of enablers, solutions are being studied to link them to COFS. A K9 capability is being developed, exploiting lessons learned from the international community, the UK, the US and Israel having such assets in their organisation. Compared to standard K9 assets, those dedicated to SF must be able to insert/infiltrate using SF methods (including HALO/

An Italian Air Force HH-101A CSAR helicopter belonging to the 15th Wing. These assets are part of the SOF capability although not under COFS command, while in the future a Joint SF Helicopter unit might be formed.

HAHO), must be trained to operate among noise and explosions and so on, bearing in mind that the K9 is not just the dog but the handler, too. The same is true for EOD/IEDD teams as well as for psyops teams, the latter having already trained some of their specialists for this task, being the 28th PsyOps Regiment part of the Army SF Command.

A key element for SF is communications; until now, some elements of the 11th Signal Regiment were assigned to COFS. In the new organisation, the signal company currently assigned as communications support will be dedicated to COFS. While SATCOM will remain its core business, it is able to work in the whole RF communications spectrum and is acquiring new capabilities provided by recent technologies that allow the creation of local nets. As for EW, these enablers will not be available as dedicated assets, but will remain earmarked for operating with SF.

Recruitment and Retention

The main weapon systems of SF units are the operators themselves. As in most militaries, Italian SF personnel are recruited within the services, with officers, NCOs and troopers being assigned to Special units after passing selection and undergoing special training. As numbers are quite small, Tier 1 operational personnel should not exceed 500. Since missions are increasing in number, so is high op-tempo which has a negative impact on different fields, training being the first, as not much time is left to maintain typical SF skills, which require time to be built up and constant refresher training to be maintained. In recent missions, Italian SF took part mostly in combat operations, while many of their special skills went unused. Skydiving, scuba diving, climbing, skiing, as well as many other skills thus have to be maintained once personnel are back at the unit. How much the new organisation and the increased capabilities of Tier 2 units will allow the high op-tempo to be eased, remains to be seen. The little time at home creates another problem, namely in the private life of personnel; prolonged time spent in operations takes its toll on families, with the effect that SF are not as attractive as one might think.

Salary is another key issue for recruitment. At the moment, only Tier 1 personnel receive an allowance for their specific role. Once the operator leaves the unit due to age, physical or other problems, he immediately loses the allowance. To attract young operators, incentives must be created that should be distributed across the entire SOF compartment, possibly at different levels. The almost-permanent willingness to take higher risks both during training and in the operation and the aquisition of several skills must be rewarded and the reward must also be maintained after several years in SF units and SF support units. This is currently being examined and solutions must be found if the number and quality of Italian SF is to be increased.

A Change in Capabilities

The transformation of the Italian Special Operations Forces triggered by the signature of the ChoD leads to a change in the capability profile. Some abilities like firepower are still in full development. Organic firepower makes it possible to build up an expedition force with a high degree of survivability, the disadvantage being the increased logistical footprint, which means a higher signature and longer deployment time.

A balance must be found between operational capability and survivability, which can vary according to use. Direct fire is provided mainly by man-portable missiles, with Italy using Rafael's SPIKE, the first of which appeared in the 9th "Col Moschin" armoury long before its introduction in the army. These weapons are currently used by the "Col Moschin" and the 4th Alpini Parachute Regiment. The missile has a new warhead designed to maximise its effect against targets other than MBTs. The 4th Regiment is responsible for indirect firepower, with the exception of the 60mm Commando mortars. The regiment is currently equipped with the EXPAL 81mm MX2-KM, recently acquired by the Italian Army for its infantry regiments and deployed within the support platoon of each infantry coy.

In terms of terminal effect, the 81mm round has a much higher effect than a 60mm one, while its overall weight allows for high mobility, even on foot. These weapons are usually used in combination with a wheeled vehicle, usually the Iveco LMV known as LINCE (LYNX).

During operation, a fire control team made of two people would deploy; the fire team itself would consist of four people.

The 4th Regiment is currently studying various options that would allow it to deploy the 81mm mortar in different ways, for example by helicopter. Such a weapon can be easily embarked on a helicopter for stand-off "shoot and scoot" attacks, while for quick redeployment over short distances a net can be used if the helicopter is required, in order to reduce the time needed. New mobility means such as the Polaris MRZR4 is being considered in order to create a heli-portable package. Firing the mortar from the LMV platform is another issue, while the regiment could in the near future receive its first Thomson-Brandt RT 61 120mm rifled mortars, which constitute a real artillery system. Its recoil makes it ill-suited for use on vehicles without wearing out the platform in the long run, but a towed solution would considerably reduce mobility. How much their range can compensate for this remains to be seen. The 4th Regiment staff is busy in developing new techniques, tactics and procedures, and results should be available in the near future.

"The expressed capability of the 'special forces' and 'special operation forces' will be reinforced and further integrated in order to work synergistically with conventional forces. The support systems for these forces must be strengthened in terms of efficiency, effectiveness and size. The process of 'institution building' and 'stabilisation' by the defence must be robust, especially with regard to equipping and training the security forces in the country in which they operate." These sentences are taken from the Italian Defence White Paper published in 2015, the aim of the above-mentioned measures being to comply with what is stated in that document. ■

At the Frontline of Cyber War

Alex Horobets

Ukraine has become the front line in the global hybrid war. The Ukrainian state has taken up the challenge and is establishing institutions to defend itself against cyber attacks.

On September 11, 2001, new rules of the game were established that were recognised by politicians, strategists and analysts almost immediately after the terrorist attack in the USA. With stolen aircraft, a small group of terrorists can even attack a superpower with a huge military budget like the United States. The group has done far more damage than would have been possible with conventional methods. In the modern world, any country can be attacked without bombs and bullets, and that is one of the characteristics of hybrid wars. Something similar happens in the information area. A cyber attack or hacking a computer does not require a large number of people.

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The components of cyber war are propaganda, espionage, attacks on computer systems, and so on. Increasingly, elements of hybrid warfare such as information operations (to influence the state and the military leadership of the opponent), cyber attacks on the state and commercial infrastructure (to deactivate the opponent's critical infrastructure and gain access to sensitive information) and psychological operations (to weaken the opponent's fighting spirit and create a climate of mistrust in society) are used.

Recently Ukraine has become the front line in the global hybrid war, and information campaigns against the Ukrainian state are the order of the day. These confrontations know no borders, which was reaffirmed on 21 June 2018. The National Cybersecurity Communications Integration Center (NCCIC) of the United States has warned institutions and companies that on the eve of the Ukrainian Constitution Day (June 28, 2018) there is a possibility of cyber attacks similar to the "NotPetya" virus. American companies advised their employees not to open suspicious letters on their computers. Similar warnings appeared on American monitors last year, so the NCCIC warning on that day was not accidental. On 27 June 2017, on the eve of the Ukrainian Constitution Day, there was a major cyber attack on Ukrainian banks, energy systems, state ministries, national mobile operators and other organisations that spread to other countries.

The attack was later called "mysterious". Oleg Derevianko, chairman of the Ukrainian company for cyber security (ISSP) notes that the virus of 2017 was more subtle than the typical malicious software, but the purpose of the attack was not a blackmailing one. ISSP proposed the term "Massive Coordinated Cyber Invasion" to distinguish the events of June 2017 from earlier cyber attacks on Ukraine in 2015-2016.

The press centre of the Ukrainian security service stated that the Russian secret services were responsible for the cyber attacks on 27 June 2017 and pursued the destabilisation of the country. The New York Times later claimed that the Petya virus was developed by the US National Security Agency and then stolen by hackers. The Council of Economic Advisers at the President's office presented a list of countries that regularly launch cyber attacks to achieve political, economic and other goals. These include Russia, China, Iran and North Korea.

The Russian Federation's activities in the international media space are aimed at spreading propaganda ideas and disinformation. Information warfare is characterised by the dissemination of a distorted perception of events and favourable stereotypes. If the attacker succeeds in achieving overwhelming control of the information space, the local population will end up leaning towards a simplified perception of reality. The main task of such a policy is to spread uncertainty and to obscure the actual development of events.

Photo: Ivanti

While "Petya" was a typical ransomware virus, the virus used in the Ukraine cyber attacks was a modified version of "Petya" and was subsequently named NotPetya to distinguish it from the original malware. NotPetya encrypted all of the files on the infected computers.

The Kremlin has established a multilayered system of structures and organisations to comprehensively influence foreign states in the information space. The effectiveness of Russia's permanent presence in the information space of foreign states is achieved through an integrated approach of propaganda. Russia has a presence in the global media space from central to regional media, web publications, interest groups in social networks, television stations, and so on. In addition, foreign media representatives are active in Russia, and representatives of foreign media are involved in public friendship organisations between Russia and other countries.

Let us remember that Russia has already gained experience in hybrid warfare in the military conflict with Georgia, where Russia exploited the historical, political and ethnic division of the country for its own purposes. In 1999, Tbilisi officially declared a policy of Euro-Atlantic integration, while refusing to extend the Russian military bases in Georgia. When Georgia applied for NATO membership at the Prague Summit in 2002, Russia began issuing Russian passports to the inhabitants of South Ossetia, thus creating an artificial Russian diaspora, which was used by the Kremlin in August 2008 as an argument for military intervention to "protect its citizens".

In Abkhazia and South Ossetia, Russia has strengthened local proxy regimes pursuing a policy of integration with Russia. Only Russian media were broadcast in these regions. Since 2004 Georgia has intensified its diplomatic efforts to internationalise the peacekeeping contingent, which consisted exclusively of Russian soldiers, but Russia blocked these Georgian initiatives.

Following the proclamation of Kosovo's independence in February 2008 and in the run-up to the NATO summit in Bucharest, at which the possibility of granting Ukraine and Georgia an action plan for membership was to be discussed, Russia intensified its policy in Georgia's conflict regions. In April 2008, Russia increased the number of "peacekeeping" contingents in Abkhazia, thus enlarging its heavily armed landing forces.

In June-July 2008, the Russian media conducted an anti-Georgian campaign and published fake reports of alleged Georgian plans to invade Abkhazia. Together with Abkhazia, from 15 July to 2 August 2008 Russian forces of the North Caucasus Military District conducted the major exercise "Kavkaz-2008."

In addition to military training, Russia has actively used elements of information warfare and carried out hacker attacks on Georgian state and information sites since the end of July 2008. On August 1, Russian journalists arrived in Tskhinvali. They have been accredited by the Ministry of Defense and the Ministry of Foreign Affairs of the Russian Federation. In so doing, Russia has tried out various tactics of the hybrid war in Georgia, which were later used in Ukraine.

Among the best-known cyber attacks on Ukraine since 2014 are the DDoS attack and a virus on the servers of the Central Election Commission in May 2014. The attack was stopped by disconnecting the servers from the Internet. Nevertheless, the Russian media broadcasted news about "the election victory of Dmytro Yarosh", who was head of the organisation "Right Sector" in the years 2014-2015 and about whom Russian media created numerous fake news. In an interview for the Ukrainian magazine" The Ukrainian Week", Valentin Petrov, Head of the Information Security Service of the National Security and Defense Council of Ukraine (NSDC), said that a joint working group was formed after the hacker attack on the Central Election Commission. This group includes the Central Election Commission, the State Service for Special Communications and Information Protection of Ukraine, the Security Service of Ukraine and the National Police.

In December 2015, the Black Energy malware virus struck the offices of regional energy utility companies in Ukraine; in the regions of Kiev, Ivano-Frankivsk and Chernivtsi, about 200,000 consumers had no electricity.

In December 2016, the Black Energy malware virus hit the "Southern" substation of the "Ukrenergo" company, leading to a temporary power outage in Kiev region. At the same time, the same virus struck the National Bank of Ukraine, the Ministry of Finance and the State Treasury, resulting in late payments of salaries and pensions.

In 2017, the worldwide cyber attack of WannaCry ransomware targeting computers running Microsoft Windows caused great damage worldwide; the virus demanded a ransom money for unlocking it. Although the virus affected about 150 countries, the largest number of infected computers was in Ukraine, Russia, Britain,

Spain, Germany, and Taiwan. Among the victims were organisations and companies such as the National Health Service of Great Britain, Telefonica (Spain), Deutsche Bahn (Germany), Sberbank (Russia) and others.

In October 2017, the Bad Rabbit virus, developed for the Microsoft Windows operating system, infected many computers in Ukraine in a number of state enterprises (including the Ministry of Infrastructure), causing a temporary shutdown of the information systems of Kiev Metro and Odessa Airport.

With every hacker attack on Ukraine, experience with countermeasures increased, both at the state level and among private information security companies.

A BBC Future broadcast featured the course of action during the hacker attack on 27 June 2017: At 10:30 a.m., the Situational Center of the National Security and Defence Council of Ukraine received a warning of a cyber attack. Its chairman Oleksandr Turchynov later said that thirty minutes later a cyber security expert came to him and ordered the team to apply a sequence of actions approved by the National Cybersecurity Coordination Centre in the event of an attack. In addition, a video conference was held immediately, attended by the heads of the State Service for Special Communications and Information Protection, the Cyber Police, the Security Service of Ukraine and the headquarters of the National Security Council.

In turn, the head of the Centre for Cyber Defence, Roman Boyarchuk hired a special team of Computer Emergency Rehabilitation (Cert UA) to find out what is known about the attack. Ukraine has a network of computer emergency response teams (CERT) and Cert UA has already become its main centre. Specialised teams have also been set up at the Security Service of Ukraine, the Ministry of Energy and the National Bank of Ukraine. In the case of the Petya/NotPetya cyber attack, information security experts have been able to determine how the virus spread during the first hours of virus activity and what measures need to be taken to stop the virus from spreading even further. But even with protection systems and reaction centres, there will not be absolute safety because of the human factor. Especially the negligence of civil servants and administrative staff makes it easier for hackers.

This became clear during the flash mob organised in 2017 by Ukrainian Cyber Alliance activists who gained prominence for publishing the 2016 correspondence of Russia's presidential advisor, Vladislav Surkov. The cyber activists wanted to draw attention to the vulnerabilities of the information networks of state institutions. The spokesman for the Ukrainian cyber alliance, with the alias Sean Brian Townsend, explained that their organisation had not hacked anything, but only made information available to the public. He said that the most common security holes in government institutions are password-free network drives and open FTP servers, with the threat of data loss and possible hacker attacks. The result of the flash mob was ambiguous: some state institutions were grateful for having identified their vulnerabilities, while others were nervous. But the question arises as to whether one should publicly highlight weak points or whether one should rather silently warn the security services of state institutions. Nonetheless, the action was a motivator to improve the security of information networks, especially in regional centres. As a result, many gaps in the security of public systems have been closed.

Many thought that cyber attacks on Ukraine had already peaked. But is that really the case? In view of the experience of the presidential elections in the United States and France, the forthcoming presidential elections in Ukraine in 2019 should be well prepared. According to the spokesman of the Ukrainian Cyber Alliance, Sean Townsend, the Ukrainian authorities should be better prepared to hold the elections, given the Russian intervention in 2014. But Ukraine must prepare for both an information war and combined hybrid attacks. Even the US admits that it does not have absolute protection against cyber threats; in the document "Recommendations to the President on Securing America's Cyber Interests and Deterring Cyber Threats through International Engagement" of 31 May, 2018, "bad cyber security practices" are considered the greatest threat.

That is why the United States has drawn attention to Ukraine. American experts believe that Ukraine's support in the fight against cyber attacks will help the US to develop new, more effective cyber security technologies and strategies. On 7 February 2018, the House of Representatives of the US Congress voted for the draft "H.R.1997 - Ukraine Cybersecurity Cooperation Act of 2017", which strengthened cooperation between Ukraine and the United States in the field of cyber security. Full implementation of the draft requires the support of the Senate and the signature of Donald Trump. Cyber security cooperation includes US support for Ukraine in improving the security of government systems, reducing dependence on Russian information and communication technologies, exchanging information on cyber security and cooperation in cyberspace. The document also talks about "misinformation and propaganda efforts in cyberspace supported by Russia" and "pro-Russian propaganda and cyber attacks". Obviously, US legislators are adopting a harsher language with regard to Russia's actions in the information space.

On 5 October 2017, the Ukrainian legislature passed the law "On the Basic Principles of Safeguarding Ukraine's Cyber Security", which entered into force on 9 May 2018. At the moment, it is the most important document protecting cyberspace in Ukraine. The law defines the main objectives and principles of public policy in the area of cyber security and the powers of public authorities in this area. The law does not apply to social networks and private electronic information sources on the internet unless they have information that must be legally protected.

It is important to point out that the law defines public-private interaction in the field of cyber security by providing a basis for timely detection and neutralisation of cyber threats, for the exchange of information between private companies and public authorities, for increasing the digital competence of the population and for establishing a training system for specialists.

Previously, there was only Ukraine's cyber security strategy, adopted by presidential decree in 2016, which confirmed the course for European integration. The Law "On the Basic Principles for Ensuring Cyber Security of Ukraine" implemented the concept of cyber security and cyber protection in the legal sphere. In many ways, the 2017 cyber attack dictated the need for such a law. The adoption of the Cyber Security Act therefore initiates the process of regulating cyber security. Although a law is not able to guarantee cyber security, it creates the basis for its further improvement.

Experts from Deloitte recommend that the Ukrainian government draw up a list of critical infrastructure facilities. Based on the experience of Western countries, such institutions require clearly defined cyber security standards. For example, the national standards of Germany, the USA, Great Britain and the International Organization for Standardization (ISO) have a high technical level.

We cannot expect cyber threats to the world and Ukraine to decrease in the near future. It is therefore essential to be prepared to respond comprehensively and flexibly to these threats. But compared to 2014, some things have changed fundamentally: In countries where major hacker attacks have taken place, cyber attackers have lost the element of surprise, and we have learned that security in cyberspace cannot be ignored in the 21st century. ■

Cyberspace Operations: The Pentagon's Approach

Sidney E. Dean

The Pentagon has been aware of the internet's potential as a defensive and offensive warfighting domain for more than two decades.

Photo: USAF

The Air Force Information Warfare Centre was established in 1993, collocated with the Air Intelligence Centre at Kelly Air Force Base, Texas. At the time, the concept of Information Warfare (IW) was being formalised and encompassed everything from propaganda operations to kinetic destruction of communication nodes, and it included what would later become known as cyberwarfare. The Centre's IW Battlelab would be instrumental in refining concepts, discovering vulnerabilities, and integrating the IW element into military exercises.

In 1995 the US Air Force established the first operational IW unit, the 609th Information Warfare Squadron. Attached to 9th Air Force (AF), the squadron's primary mission was to deploy with 9th AF units to protect information systems established at expeditionary sites, and to advise the theatre commander on IW threats. While billed primarily as a defensive unit, the 609th IWS retained an offensive capability.

Much has happened since then. Cyberspace was elevated to the status of a warfighting domain in 2011. This places it on par with Land, Air, Sea and Space as an "environment" for the conduct of military operations. Today all services have dedicated cyberwarfare commands to serve the defensive and offensive needs of their combat forces and support infrastructure.

Photo: Chief Petty Officer Dennis Herring, USN.

Sailors work together at a joint cyber training centre in Fort George G. Meade, MD, during an April 2017 exercise.

Photo: US DoD

General Paul Nakasone is Commander, US Cyber Command, and simultaneously director of the National Security Agency and chief of the Central Security Service. He previously led the US Army Cyber Command.

US Cyber Command

While they remain integral components of their respective services, these four commands are also component commands of the joint US Cyber Command (USCYBERCOM). Established in 2009 as a unified subcommand of US Strategic Command, USCYBERCOM was elevated to a full combatant command on 4 May 2018. This places it on par with US Strategic Command, US Space Command, US Special Operations Command, and six other top-level joint warfighting commands. USCYBERCOM's new commander, General Paul Nakasone, now reports directly to the secretary of defense. According to the official mission statement the command "plans, coordinates, integrates, synchronises and conducts activities to direct the operations and defence of specified Department of Defense [DoD] information networks and prepare to, and when di-

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Photo: US Army

The US Army's Cyber Mission Unit Cyber Operations Center at Fort Gordon is home to signal and military intelligence NCOs who watch for and respond to network attacks from adversaries as varied as nation-states, terrorists and "hacktivists".

rected, conduct full spectrum military cyberspace operations in order to enable actions in all domains, ensure US/Allied freedom of action in cyberspace and deny the same to our adversaries." This includes establishing training and operational standards, establishing procurement priorities, and building up the Cyber Mission Force (CMF) consisting of qualified cyber operators.

On that front, a milestone was achieved on 17 May of this year when CMF declared full operational capability (FOC) for all of its 133 operational teams. Building up these teams, which consist of a total of 6,200 military and civilian personnel, had been initiated in 2012. These teams, drawn from across DoD, are organised into: Cyber Protection Teams (CPT) to defend key DoD networks and systems; National Mission Teams (NMT) to defend the United States and its interests against cyberattacks of significant consequence; Combat Mission Teams (CMT) to support combatant commands by generating integrated cyberspace effects in support of operational plans and contingency operations; and Cyber Support Teams (CST) which provide analytic and planning support to National Mission and Combat Mission teams.

According to US Cyber Command, some of these teams are aligned to functional and geographic combatant commands to support combatant commander priorities and synchronise cyberspace operations with operations in the other four domains. Others are aligned to the individual services for defensive missions. The balance report directly to subordinate command sections of USCYBERCOM: the Cyber National Mission Force (CNMF) and Joint Force Headquarters-DoD Information Network (JFHQ-DoDIN). As outlined by USCYBERCOM, the CNMF plans, directs and synchronises full-spectrum cyberspace operations to deter, disrupt and if necessary, defeat adversary cyber actors to defend the nation. National Mission Force teams are aligned to support the CNMF. JFHQ-DoDIN, which also achieved FOC this year, provides command and control of DoD information network operations, defensive cyber operations and internal defensive measures globally to enable power projection and freedom of action across all warfighting domains.

These measures are all in compliance with the new National Defence Strategy published in January of this year, and which states that the Pentagon will "invest in cyber defence, resilience, and the continued integration of cyber capabilities into the full spectrum of military operations."

Photo: Capt. Meredith Mathis, US Army

A cybersoldier, assigned to the 780th Military Intelligence Brigade, prepares his equipment inside a STRYKER vehicle during an integrated cyber exercise on Joint Base Lewis-McChord, WA, 21 October 2015.

Cyberspace Operations – Acts of War?

The United States and US allies face a plethora of diverse cyberspace threats, from non-state actors to technologically competent mid-tier nation states such as Iran and North Korea, and the two peer-level rivals Russia and China. The cyber threat is not restricted to military or government systems. As the 2018 National Defence Strategy states, "increasing digital connectivity of all aspects of life, business, government and military creates significant vulnerabilities." Disinformation and destabilisation campaigns such as those recently waged by Russia to undermine elections and political stability in the United States and Europe are one example of this. Current cyber aggression – whether hacking for espionage, placement of malware, or disinformation operations – is generally thought to constitute actions below the threshold of war, although individual US politicians and commentators describe cyber-based interference in the 2016 US elections – perpetrated by Russian military intelligence – as an act of war rather than as an intelligence operation.

While the ability to influence elections – potentially by hacking into vote-tallying systems or manipulating voter registration databases – is nefarious, there remains much potential for escalation. The threat that state or non-state hackers could systematically and on a large scale sabotage banking, hospital, air traffic safety, or public utility networks has long been discussed. Such attacks could at best cause chaos and at worst lead to death and destruction. Such attacks could be perpetrated by a nation-state aggressor to weaken the United States immediately before a military offensive against the US or allies. The term "Cyber Pearl Harbor" has been used for the prospect of a massive cyber attack on infrastructure and communications systems which would – at least temporarily – cripple US society and hamper

a military response. Former Chairman of the Joint Chiefs of Staff, Admiral Mike Mullen, described such an attack as one of two "existential" threats to the United States, the other being a nuclear attack.

Cyber Warfare and International Law

The United States has long maintained that international law applies in cyberspace. This includes the law of armed conflict, which recognises the right to individual and collective self-defence. Neither the United Nations nor the United States have to date established a formal definition of what constitutes an act of war or armed aggression in cyberspace. On Washington's part such ambiguity may be calculated, in order to preserve flexibility and options. Beginning with the Obama administration's 2011 International Strategy for Cyberspace,

Photo: US Army

A soldier assigned to the 780th Military Intelligence Brigade at Fort Meade, MD, sets up low-level voice intercept equipment during a cyber integration exercise at Joint Base Lewis-McChord, WA, 21 October 2015.

Washington has consistently maintained the position that major cyber offensives against the United States, its allies or interests could be considered acts of war, opening the option for the US to respond with conventional military means, cyber operations, or a combination of both. In 2012, the State Department's legal counsel Harold Koh provided a nonbinding threshold definition, stating that a cyber attack that resulted in death, injury or significant destruction would be viewed as an armed attack justifying a military response. As examples of such "cyber attacks of significant consequence" Koh cited causing a nuclear power plant meltdown, opening a dam above a populated area, or disabling the air traffic control system.

Photo: Bill Roche, Army Cyber Command

A member of the 780th Military Intelligence Brigade sets up deployable cyber tools overlooking the mock city of Razish at the National Training Center at Fort Irwin, CA, 5 May 2018.

This leads directly to a second question: Must the reaction to a cyber attack be proportional? In practise this is largely a question of policy. The Obama administration committed itself to proportional response, but in principle the US government consistently reserves the right to apply military power as it deems necessary and appropriate to defend national interests and commitments. In practice, a kinetic military response – which would be viewed internationally as an escalation – is unlikely unless the cyber attack caused mass casualties, extreme and non-transient destruction, or is deemed with a high level of probability to be the precursor of a conventional offensive. As for offensive campaigns by US military forces, the recognition of cyberspace as a warfighting domain has institutionalised the concept that – within the limitations of US and international law including the law of war and relevant international conventions – a first strike via cyber operations is as legitimate as one conducted by aircraft or missiles.

Offensive and Counter-Offensive Cyber Operations

In the US, primary responsibility for cyber infrastructure defence rests with the civilian Department of Homeland Security, with DoD prepared to act in a supporting role. If the President determines that the threat warrants a cyber-counterattack, the Pentagon assumes operational responsibility.

The first challenge for planning a cyber-counteroffensive is determining with adequate certainty who actually initiated the original attack. As then-Secretary of Defence Chuck Hagel noted in 2013, "attribution is not impossible, but it is not as simple as identifying a navy sailing across the ocean or an army crossing a border to attack you. This is a fundamentally different, more insidious kind of threat than we've ever seen – one that carries with it a great risk of miscalculation and mistake." Retaliation against the wrong party would simply further the goals of the true perpetrator.

In addition to defensive or retaliatory cyber operations, the United States has integrated offensive cyber warfare into its war planning. Operationally, counteroffensive and offensive cyber manoeuvres utilise the same tactics and technology. Cyber attacks to disable an adversary's military command, control and communications (C3) systems is now an alternative to physically striking these facilities. Attacking an adversary's key infrastructure is also an option. Such offensive operations could be conducted alone, to degrade an adversary's capabilities and serve as a bloodless warning shot that the US is prepared to escalate operations. Alternately, cyber operations preceding and during a physical offensive are also integral to modern US operational doctrine. For example, during the Obama administration, the Pentagon prepared plans for a cyber attack on Iran's military C3 and air defence networks; these plans would have been implemented prior to any air campaign against that nation.

Ideally, such operations would be planned well in advance, preparing the ground by infiltrating malware into adversary networks. The latest technique for contaminating air-defence or command-and-control systems employs manned and unmanned electronic warfare aircraft. Since defensive and offensive cyber operations are now integrated with conventional military operations, Information Warfare teams are also set to deploy into the field with combat units. These IW specialists are separate from USCYBERCOM, and subordinate to their respective service branch. For example, the Marine Corps is standing up the Marine Expeditionary Force Information Groups, which will unite all information operations including electronic warfare, signals intelligence, and cyber operations. Additionally the USMC will form dedicated expeditionary defensive cyber companies,

formally designated as defensive cyberspace operations-internal defence measures (DCO-IDM) units. These companies will be separate from USCYBERCOM and provide an organic defensive cyberspace capability to expeditionary units. Similar cyber teams are being developed by the other service branches to shield the information systems of deployed combat units and field headquarters from tactical cyber attacks.

Calls for Proactive Cyber Posture

The cyberdomain is comparatively new, and remains in flux. New technology and operational experience require doctrine and tactics to be constantly refined. The results of a year-long study by the Defence Science Board (DSB) were released in July 2018. The DSB study warned that the United States "has fallen behind its competitors in the cyber domain, both conceptually and operationally." Recommendations include: progressing from the current focus on tactical outcomes, to devising a concept of cyber operations to achieve strategic effects; streamlining the cumbersome approval process for cyber operations, which currently require national command authority clearance, by delegating approval authorisation to the commander of USCYBERCOM and a standing cadre of "approvers" at the National Security Council; identifying actions DoD may take under standing rules of engagement; acknowledging that the United States is now constantly at some level of conflict or competition in cyberspace. In a memo accompanying the report, the two DSB co-chairs also criticised that US military cyber operators currently do not receive sufficient real world experience. "At present, cyber operators do not get the exposure they need to make them proficient at their craft. Additional training can help, but there is no substitute for actual contact in the field."

The report will have been favourably received by General Nakasone. USCYBERCOM's new commander has stated a preference for a more aggressive US posture in cyberspace. He believes this should begin in peacetime, with an aim to deter foreign aggression.

The command vision for USCYBERCOM, published in April of this year under General Nakasone's guidance, is titled "Achieve and Maintain Cyber Superiority." Noting that achieving superiority in the physical domain depends today in no small part on superiority in cyberspace, the document finds that current US policies – including a "traditionally high threshold for response to adversary activity" and "lengthy approval processes that delay US responses"– risk ceding cyberspace superiority and ultimately endangering mission success.

The document cites ongoing DoD efforts to develop the technologies and framework to effectively counter cyber aggression, and calls for policy changes that will permit the effective use of these resources. Specifically, the new command vision calls for a forward defence posture which manoeuvres seamlessly between defensive and offensive operations. "In this dynamic environment, the United States must increase resiliency, defend forward as close as possible to the origin of adversary activity, and persistently contest malicious cyberspace actors to generate continuous tactical, operational, and strategic advantage. We achieve success by seizing the initiative, retaining momentum, and disrupting our adversaries' freedom of action." Such a strategy would help locate adversaries' weak points, force opponents to shift resources from offensive operations to protect their own systems, and potentially deter some hostile actors from continuing their aggression, whether in cyberspace or in other domains.

Photo: Bill Roche, Army Cyber Command

An Expeditionary Cyber-Electromagnetic Activities Team member surveys the battlefield near the mock city of Razish.

Cyber Strategies Due Soon

General Nakasone might get his wish. In May the Pentagon began an internal cyber posture review which is expected to be completed in August. The review is mandated by the 2018 National Defence Authorization Act (NDAA), and it is intended to clarify the US near-term cyber deterrence policy and strategy. This includes the role of DoD's cyber forces within the overall defence strategy and planning, as well as their significance for warfighting commands. The review will lead to formulation of a new Cyberspace Strategy, replacing the strategy which has been in place since 2015. Significantly, the review is required to make "a declaratory policy relating to the responses of the United States to cyber attacks of significant consequence."

In Congress there is support for a more aggressive US cyber posture. The recently completed 2019 NDAA (which is expected to pass Congress in August) grants DoD new authorities to deter and respond to cyber attacks. This includes offensive cyber operations against adversaries. A congressional conference report on the NDAA summarises that it "establishes a policy that the United States should employ all instruments of national power, including the use of offensive cyber capabilities, to deter if possible, and respond when necessary, to cyber attacks that target US interests." Such a response should be authorised if a foreign actor perpetrates a cyber attack to intentionally "cause casualties, significantly disrupt the normal functioning of our democratic society or government, threaten the Armed Forces or the critical infrastructure they rely upon, achieve an effect comparable to an armed attack, or imperil a US vital interest."

The NDAA expressly authorises DoD to take action against networks and infrastructure in neutral third countries through which a hostile cyberattack is transmitted, if the government of the third nation is unable or unwilling to eliminate the threat.

The NDAA also establishes the so-called Cyberspace Solarium Commission, to be composed of fourteen individuals including deputy secretaries or directors of the Defence and Homeland Security departments as well as intelligence and counterintelligence agencies. The commission is charged with conducting a twelve-month study to develop a consensus on a strategic approach to defending the United States in cyberspace against cyber attacks of significant consequence. ■

Amphibious Warfare

Current Programmes on a Global Scale

Jack Richardson

In the last century there were several large-scale amphibious landings around the world, from D-Day and the Pacific campaign in World War II to the Incheon landings and the Falklands War. More recently, the US and UK forces invaded Iraq from the sea across the Al Faw Peninsula in 2003, and there have been amphibious elements to the ongoing Saudi-led intervention in Yemen. That is why the British Ministry of Defence sees amphibious capabilities as being important in the future.

The importance of amphibious operations continues to endure, with the UK MoD's "Future Operating Environment 2035" document singling out the littoral (particularly where urban areas are concerned) as a key operating environment going forward.

United States

Currently, the force offering the most advanced and comprehensive range of amphibious capabilities is the US Marine Corps (USMC), which deploys seven Marine Expeditionary Units (MEUs, three on each seaboard and one in Japan) to meet contingencies. They can be scaled up in size if necessary, but each consists of a battalion-sized unit of Marines as standard, augmented by artillery, reconnaissance and armoured elements in addition to logistics and aviation units. Respectively, these are termed Ground Combat Element (GCE), Logistics Combat Element (LCE) and Aviation Combat Element (ACE). Each MEU of 2,200 personnel is overseen by a Command Element.

The MEU is integrated with an Amphibious Ready Group (ARG). The ACE (centred on the MV-22 OSPREY tiltrotor, supported by helicopters and AV8B HARRIER IIs, which are being replaced by the F-35B) is embarked in either a WASP class Landing Helicopter Dock (LHD) or an AMERICA class Landing Helicopter Assault (LHA). They also carry part of the GCE with capacity for 1,687 Marines, who can be transported ashore using either three Landing Craft Air Cushion (LCAC) or two Landing Craft Utility (LCU) held in a well dock at the stern. This facility will feature in the AMERICA class from LHA8, it was omitted from LHAs 6 & 7 to prioritise aviation). These play a significant role in transporting the GCE and LCE to and from shore, able to carry 75 and 125 tonnes of equipment respectively. Within the ARG, the Landing Ship Docks (LSDs) of the HARPERS FERRY, WHIDBEY ISLAND and ANCHORAGE classes provide logistical support. The other core component of the ARG and MEU is a Landing Platform Dock (LPD) of the SAN ANTONIO class. These were designed to replace various legacy classes and carry up to 800 Marines and their equipment, who can be ferried ashore with either two LCAC or a single LCU. Additionally, the SAN ANTONIO class can carry up to fourteen Assault Amphibious Vehicles (AAVs). Despite being able to carry up to 25 Marines from ship to shore, the vehicle is now reaching obsolescence and is due to be replaced by the Amphibious Combat Vehicle (ACV). The winner of the competition was announced in June 2018 as the Iveco SUPERAV 8x8, after many years of evaluation following the cancellation of the Expeditionary Fighting Vehicle. With an initial contract for 30 vehicles with an option for up to 204 more to fully replace the AAV in incrementally upgraded variants by 2035, the SUPERAV will have a crew of three and up to thirteen Marines with the capacity for various weapon payloads. This baseline vehicle, and a dedicated Command and Control (C2) variant, will have greatly improved mobility and protection over the AAV and will be able to keep up with the M1 ABRAMS Main Battle Tank (MBT) and the Light Armoured Vehicle 25 operated by the USMC.

Graphics: U.S. National Archives

An artist's concept of LHD-1, similar to the LHA-1 amphibious assault ships. LHD-1's primary mission is to embark, deploy and support all elements of a Marines landing force, using amphibious vehicles, helicopters and HARRIER aircraft. The electronic and communication systems of the 844-foot ship allow it to serve as a command post.

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The other shortlisted vehicle for the ACV requirement was the TERREX 2 APC from Singapore Technology (ST) Kinetics who had partnered with US contractor SAIC to produce this 8x8, V-hulled vehicle. Able to carry eleven passengers in addition to a three-member crew, the TERREX 2 evolved over the original TERREX to operate at up to SEA STATE 3 and, like many other vehicles, can be equipped for different roles. At the same Expo, ST Kinetics showcased the latest member of its BRONCO family. Composed of two tracked cabs, this amphibious vehicle is marketed as being able to operate in different terrains from mountain ranges to desert environments in a variety of roles from troop-carrying to C2 and ambulance.

The UK

A similar vehicle called the VIKING (built by BAE Systems, Land Systems Hägglunds of Sweden) was operated by the Royal Marines (RM) in Afghanistan to great effect. The RM is built around 3 Commando Brigade, which trains for a variety of amphibious contingencies. It comprises three battalion-sized formations (one of which is optimised for maritime security operations) alongside supporting artillery, logistics, engineer and intelligence elements (some of which are detached from the British Army). The brigade also features 43 Commando Fleet Protection Group, responsible for guarding the UK's nuclear deterrent at Her Majesty's Naval Base Clyde in Scotland. For its traditional role of amphibious warfare, 3 Commando Brigade relies upon the two ALBION class LPDs. These 19,000-ton vessels can routinely carry 256 troops and their equipment (with a surge capacity of 405) in addition to up to 30 armoured vehicles or six CHALLENGER II MBTs. These are ferried ashore from the Landing Craft Vehicle and Personnel (LCVP) Mk 5, which can transport a company of fully equipped Marines (or an armoured vehicle similar to the VIKING) over 210 NM. A larger type is the LCVP Mk 10, which can carry up to 120 Marines at 10 knots. Both of these types can also be operated from the BAY class LSD, which can carry up to 400 troops and up to 24 CHALLENGER IIs. These versatile ships, crewed by the civilian Royal Fleet Auxiliary (RFA) are also suitable for a wider variety of roles including humanitarian relief in the Caribbean and maritime security in the Gulf. The primary task in the latter is supporting the RN Mine Countermeasures Vessels in the region, but the ships have played host to US Riverine Command Boats. Furthermore, in 2012, it was reported the RFA CARDIGAN BAY acted as the base for RM VIKINGs conducting raids into Somaliland. Also, the 1998 Strategic Defence Review (SDR) made clear a requirement for six Strategic Transport Ships of the POINT class. Operated under a private contract, these ships play a key role transporting equipment around the world to support UK expeditionary operations, an example being the buildup to the 2003 invasion of Iraq.

Despite being highly capable, and also receiving an upgraded, twelve passenger, LCAC capability in 2010, the UK's amphibious forces have been through significant upheaval in recent years. In 2018, the RN's only Landing Platform Helicopter (LPH) HMS OCEAN was decommissioned and sold to Brazil. In addition to their carrier strike role, one of the QUEEN ELIZABETH class aircraft carriers will use helicopters to conduct littoral manoeuvres to fill this gap. However, given their size and potential vulnerability, this is a controversial prospect. Under the 2010 SDSR, the number of POINT class ships went from six down to four and one of the ALBION class was placed in extended readiness. Indeed, as the UK MoD battles continuing budget shortfalls, there is speculation in the UK press that these ships could be withdrawn from service altogether, leaving a significant capability gap even though amphibious capabilities remain important across Europe with a number of states renewing their fleets.

Photo: IVECO

An Iveco 8x8 SUPERAV launched from an LHD-1. The SUPERAV is capable of supporting littoral operations in open ocean beyond sea state 3. The vehicle can carry a 10 t mission load, including an overhead weapon station mounting up to a 40mm cannon. The SUPERAV platform is equipped with a new 700 hp powerpack and driven in water by two propellers.

The Netherlands

One force with which the RM retains a close relationship is the Royal Netherlands Marines. Ever since they forged close links in the Cold War to guard NATO's Northern Flank, the two forces have coordinated training for a variety of contingencies. The extent of this is such that the BAY class LSDs are derived from the Dutch/Spanish ENFORCER LPD design. The Royal Netherlands Navy retains two of these ships in service. HMNLS ROTTERDAM is able to support up to 611 troops and has a hangar that can accommodate six medium-sized helicopters in addition to a well-dock from which LCVPs can be deployed. Her sister ship is HMNLS JOHAN DE WITT which has the same aviation, C2 and hospital facilities but benefits from a double lane well-dock, from which both LCVPs and LCACs (with the parting removed) can be deployed. There is also the Joint Support Ship HNLMS KAREL DOORMAN which not only supplies fuel and solid supplies to Dutch warships around the world but contains amphibious shipping to support the Dutch Marines. The versatility of these ships is underlined by the fact that all three have operated off Somalia as motherships in the anti-piracy role. This forms part of a trend whereby roles of amphibious and other naval ships are becoming blurred. The ABSALON class support ships operated by the Royal Danish Navy are used to carry LEOPARD II MBTs, as their mission decks were designed for a broad spectrum of operations.

France

Also bolstering its amphibious capabilities is the French Marine National (MN), which over the last decade has taken delivery of three MISTRAL class LPDs. These advanced vessels enjoy extensive C2 capabilities, accommodation for 450 to 700 troops and fully equipped medical facilities. They have the ability to transport a large number of helicopters (either 16 in the medium category or up to 35 lighter types) and have greater on-board space due to azimuth thruster propulsion. From the large floodable well-dock facility in the stern, each ship can deploy two Engins de Débarquement Amphibie Rapides (EDA-R) catamarans. These large craft can achieve 30 knots and travel 400 NM with up to 80 tons on board. Images from the recent Catamaran 2018 exercise with the RN show these vessels discharging a wide range of vehicles from the French Army's 9th Brigade (its specialised, all arms, marine formation). Vehicles shown ranged from the VBCI 8x8 Infantry Fighting Vehicle to the AMX-10RC 6x6 reconnaissance vehicle.

Spain

As amphibious capabilities become more prominent in Europe, there is another design which stands out. The Spanish Armada's JUAN CARLOS I strategic projection ship was commissioned in 2010 and has a large well-dock (that can take up to four LCVPs), in addition to a fully equipped hospital and dental surgery. The ship supports the Spanish Marine Corps (who also benefit from the support of two GALICIA class LPDs, similar to HNLMS ROTTERDAM) which consists of two infantry battalions, a mechanised one (containing the AAV-7) and supporting elements. Up to 913 troops can be accommodated on the JUAN CARLOS in addition to a broad range of helicopters (twelve in the hangar and another six on deck). There is also a ski-ramp which can launch the Spanish Armada's AV-8B HARRIER II, but it is currently unclear whether funding will permit these to be replaced by the F-35B. Such are the capabilities of this ship, the Turkish Navy is procuring a similar one named ANADOLU, from which the F-35Bs may be operated.

Italy

Also in the Mediterranean, the Italian Marina Militare operates the San Marco brigade with three regiments, the first a composite, expeditionary force, the second orientated towards maritime security operations and the third towards training. The force, overseen by command and support elements, is looking to recapitalise with a new LHA/LPH type of vessel. Currently, the brigade is operated from the three small SAN GIORGIO class LPDs, from which a battalion of marines, various landing craft and three helicopters can be deployed (though they lack a hanger). As the need for amphibious capabilities has spread to the Middle East and North Africa (MENA) region, two similar ships have been procured, one for Algeria and another forthcoming for Qatar. Though they have the core features of medical and C2 facilities, these have greater offensive weaponry than traditional amphibious ships. These include an Oto Melara Rapid 76mm gun for countering surface and aerial targets in addition to a silo aft of the superstructure capable of launching MBDA ASTER air-to-air missiles which are supported by a powerful Active Electronically Scanned Array.

Photo: UK MoD

Royal Marines Landing Craft Vehicle Personnel (LCVP) Mk 5

Russia and Egypt

One of the more significant amphibious warfare developments in the region however lies on the Suez Canal. France had originally been contracted in 2011 to build two MISTRAL class LHDs for the Russian Navy. However, this purchase was cancelled in August 2015 following a backlash from the US and Eastern European states, in the context of Russian aggression in Crimea. The following year, however, France succeeded in selling the two ships to Egypt, where they were renamed GAMAL ABDEL NASSER and ANWAR EL-SADAT. These vessels provide Egypt with a valuable expeditionary capability from which aforementioned quantities of troops and armoured vehicles can be deployed. It is, however, unclear what types of aircraft the Egyptian vessels will operate, with suggestions Egypt may deploy Russian types including the KAMOV 52 coaxial rotor attack helicopter from the ships. Despite the setback of failing to purchase to MISTRAL class ships, Russia is planning a new LPH by 2022 and is procuring smaller support ships.

China

In East Asia, however, progress has been more rapid. Perhaps the most significant efforts are those of China, which has established two all-arms marine brigades with a third in the process of being stood up. To support this 20,000-strong (and growing) force, China's People's Liberation Army Navy (PLAN) has built six Type 071 LPDs. Similar to the SAN ANTONIO class, these can transport a battalion of 800 Marines and land them using LCVPs, LCACs and helicopters. China also plans to build an uncertain number of Type 075 LHAs. Displacing 40,000 tonnes, these ships will be able to carry up to 30 helicopters, offering increased power projection in the disputed South China Sea region.

Japan

This has sparked a response from Japan, which is in the process of raising significant amphibious forces in the added context of the controversial moves by Shinzo Abe's government to establish a more assertive defence policy. In 2018, the Japanese Ground Self-Defence Force (JGSDF) activated the Amphibious Rapid Deployment Brigade (ARDB). Composed of approximately 2,100 personnel, parallels have been drawn between this new unit and USMC MEUs because Japan has purchased V22 OSPREYs and AAV-7 APCs. This is in addition

to considering the purchase of new Landing Craft and, controversially, F-35Bs to operate from Japan's existing IZUMO class helicopter carriers.

South Korea

Similarly, South Korea is studying the possibility of deploying the F-35B from its DOKDO class LPHs. With one of these vessels in commission and another under construction, they possess the C2 capabilities and medical facilities to form a key part of the ROKN's vision to become a blue water navy. This is through carrying 700 Marines (South Korea has 29,000 in total over two divisions and a brigade), six tanks and AAVs in addition to LCACs.

Australia

As part of this trend of proliferating amphibious capabilities in the Asia-Pacific region, Australia has been at pains to enhance its amphibious capabilities with the commissioning of the LHDs CANBERRA and ADELAIDE in 2014 and 2015 respectively. These are derived from the JUAN CARLOS LPH operated by the Spanish Navy and are able to carry four LCM 1E Landing Craft to move up to 1,000 personnel ashore. This has meant significant changes for the Australian Defence Force, including the re-role of the 2nd Battalion, Royal Australian Regiment to provide specialist capabilities to secure the beachhead before the main force in brought ashore. These ships, which operate alongside the LSD HMAS CHOULES (procured from the RFA in 2011) have already been proven in exercises with the US and in their secondary role of providing humanitarian assistance after Cyclone Winston devastated Fiji in 2016. Amidst regional geopolitical concerns, this is also a key priority for states in the region. India purchased the former AUSTIN class LPD USS TRENTON in 2007 (there is an ongoing competition to procure four multi-role support vessels), whilst a specialist marine brigade is being raised by the Indian Army.

Photo: Crown

A Royal Marines Landing Craft Utility (LCU) Mk10 B2 conducting cross decking drills with the French Marines with a French EDA-R catamaran landing craft in the background

Photo: US Navy

A Landing Craft Air Cushion (LCAC) launches from the deck of amphibious assault ship USS BONHOMME RICHARD (LHD 6).

Singapore

One state which, as previously mentioned, has pedigree in producing amphibious vehicles is Singapore. The Republic of Singapore Navy operates four ENDURANCE class LPDs and is seeking a more capable replacement class. Alongside the TERREX 2 at Eurosatory 2018 was a private venture by Krauss-Maffei Wegmann and NEXTER which has resulted in the Amphibious Protected Vehicle Tracked (APVT). This is an amphibious APC which on land is controlled by a driver and commander sitting side by side but upon entering the water (a protective screen is erected at both ends), is propelled in the opposite direction using pump jets. Driven by a diesel engine on rubber tracks, APVT has a remote weapons station and a payload of up to five tons. To date, it has been tested over multiple types of terrain and is marketed for riverine or open water operations.

The large number of amphibious warfare projects around the world, from these next-generation vehicles to large scale amphibious shipping, underlines the increasing value of these highly specialist capabilities. ■

South African National Defence Force Modernisation

Helmoed Römer Heitman

After more than two decades of budget cuts, the equipment of the South African armed forces is so depleted and outdated that the armed forces can hardly fulfil their tasks. There is an urgent requirement for new investments, but procurement projects are repeatedly being deferred.

The South African National Defence Force faces both block obsolescence of much of its prime mission equipment and some critical capability gaps. Much of the army's combat and logistic vehicle fleet is thirty years old; the air force has no effective maritime patrol capability and lacks the airlift capacity required for any serious regional security role; and the navy lacks the ships required to protect South Africa's maritime interests. This is the result of underfunding since 1989 coupled with a decade of operational overstretch during the 2000s, which has also seriously impacted equipment maintenance, further aggravating the problem.

Photo: Horst

The South African Army will receive 242 BADGER infantry combat vehicles to equip two mechanised infantry battalions.

Author

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Acquisition Plans and Projects

There are acquisition plans and projects for most of the requirements, but most have repeatedly been 'moved to the right', and yet again this year as a result of the budget cuts over the present three-year Medium-Term Expenditure Framework (MTEF). This is the first cut in actual – as opposed to planned – funding since the 1990s and falls almost entirely on the capital budget:

- The army's acquisition budget will shrink from ZAR3.19Bn (ZAR = South African Rand) in 2017/18 to ZAR1.56Bn in 2020/21.
- The navy's acquisition budget will shrink from ZAR1.28Bn to just ZAR786.6M in 2019/20 but is planned to rise again to ZAR1.01Bn in 2020/21.
- The air force is luckier; its acquisition budget shrank from ZAR976.5M to ZAR785M but will rise again to ZAR1.34Bn and ZAR 1.58 billion in the next two years.

The budget cut is the expected result of a slowing economy and rising demand for social benefits. But after almost three decades of underfunding, it is an immense burden for the SANDF, which can no longer provide the capabilities the government expects of it. Government will either have to find the means to fund the implementation of the 2015 Defence Review or review its foreign and national security policies to align them with the military capabilities that the SANDF can assure on the likely funding. That might require dropping any pretensions to a regional security role beyond patrols of the Mozambique Channel, through which passes much of South Africa's imported oil.

The urgency notwithstanding, it is unlikely that a new review of required – or desired – defence capabilities will come before the elections in 2019. However, whatever might be decided then, there will be urgent requirements to be met if the SANDF is to be effective in whatever role is decided for it. For now, the SANDF is continuing with some projects and continues to plan for a better-funded future. Taking a positive view, this hiatus in re-equipment might not be an entirely bad thing in an era of defence technologies with very short half-lives, enabling the SANDF to review its capability requirements and acquisition strategy. A new acquisition strategy is, in fact, part of the new defence industry strategy developed for the Department of Defence.

Army Projects

The largest equipment project in hand for the army is Project Hoefyster, which is to deliver 242 BADGER infantry combat vehicles to the army to equip two mechanised infantry battalions. The vehicles will be delivered in several configurations: section carrier (30mm CamGun), fire-support (30mm), mortar (60mm breech-loading, water-cooled, 6,000-metre range), anti-tank (INGWE 5,000-metre-range

beam-riding missile), command, artillery (basic artillery observation system), command post, signals, ambulance and logistic. The first 88 production vehicles were to be delivered by the end of 2019, with all deliveries completed by 2022, but the project has hit major delays.

The BADGER is a further development of the PATRIA AMV, with a flat-bottom mine-protection system developed by Land Mobility Technologies, a Denel subsidiary that also developed the add-on armour kit, a new rear door with ammunition and section weapons stowage, and the complete interior fit, including a large chilled water tank. The vehicles will be built by Denel Vehicle Systems and then delivered to Denel Land Systems to be integrated with its Medium Combat Turret. Denel Land Systems also developed the 30mm cam-driven cannon and the 60mm 6,000-metre-range mortar for the section and mortar variants. The anti-tank variant will be armed with the 5,000-metre-range beam-riding INGWE missile from Denel Dynamics.

While company-internal problems and funding issues have caused delays to the overall project, the ancillary projects have progressed: Denel PMP has geared up to produce the 30x173mm ammunition and delivered the first batches, and Rheinmetall Denel Munition (RDM) has supplied the first batches of long-range 60mm mortar bombs. ThoroughTec Simulations has delivered the first driver and turret crew training simulators for the different BADGER variants, with 26 simulator sets to be delivered. The simulators use the company's CYBERWAR programme and the software package allows interactive simulation against an artificial intelligence enemy over a 1,500-square-kilometre virtual world.

The long-term intention is for this vehicle to be the standard platform for future medium combat vehicles, for instance for a replacement of the ROOIKAT armoured car.

The only other current major project is the acquisition of SKYSHIELD fire-control systems for the army's upgraded twin 35mm OERLIKON cannon. This is nearing completion, with the equipment already delivered. The acquisition of the UMKHONTO SAM in its ground-based launcher (GBL) configuration and a suitable radar both remain unfunded, and the planned mobile air defence systems are still far into the future.

A smaller project involves the delivery of 435 Toyota LAND CRUISERS adapted for border patrol operations. They are being delivered in four configurations – patrol, command, logistic and ambulance – and will equip all 15 infantry companies currently employed for this task.

One major project that will probably go ahead in the near future despite tight funding, albeit probably in several small batches, is the acquisition of tactical logistic vehicles to partially replace the fleet of 30-year old SAMIL trucks. A previous project – Vistula – was cancelled for nebulous reasons and over the objections of the army, and this has meanwhile become a matter of urgency. Given the funding shortage, the project promises to be somewhat smaller than previously planned but still quite substantial, involving several hundred trucks in multiple configurations. There is an idea to develop a truck in South Africa, but more likely is local manufacture of bodies for an existing truck type and perhaps licence manufacture of the chassis. Once a truck type has been selected, the army will begin to plan for a new armoured personnel carrier using the same driveline components (Project Sapula). That vehicle will either be an adaptation of an existing South African design, or a new local design, and again several hundred will be required over time.

One interesting project that is yet to be confirmed, is the acquisition of six Denel Land Systems 155mm truck-mounted T5 guns to replace six refurbished G5s that the army released to Denel to meet an urgent export order. The T5, mounted on a Tatra 8x8 platform with a protected cab, would give the army a mobile artillery system more easily transportable for operations outside South Africa than the G6. It also incorporates several newer technologies and is designed for 'shoot and scoot' fire missions to offset the lack of full armour protection as on the G6. The requirement for a light gun remains open, and the preference would seem to be to acquire the Denel Land Systems light, long-range (30 km) 105mm gun when funding allows. This has been developed in towed form and as a C-130 transportable self-propelled gun, the latter for a US Army requirement that was later dropped.

Other projects include an upgrade of the navigation and fire-direction systems of the G6, the acquisition of new tactical communications equipment from Reutech, and acquisition of new field kitchens and water purification equipment. An open requirement that may be addressed early, given its low overall cost, is for a new generation of close-range anti-tank/anti-bunker weapons.

Photo: Bob Adams

South Africa's ageing OLIFANT Mk2 Main Battle Tanks need to be replaced.

Given the government's focus on tightening border safeguarding, the army may also have to look at acquiring suitable sensors. Here the first options might be the STEALTHRAD of Reutech Radar Systems and optronic sensors from Hensoldt optronics.

Looking forward, there are projects for a 'light armoured reconnaissance' vehicle and, further into the future, for the replacement of the ROOIKAT armoured car, some of which were upgraded not long ago, and for the replacement for the OLIFANT main battle tank.

Navy Projects

The navy has placed orders for a hydrographic survey ship (Project Hotel) and three inshore patrol vessels (part of Project Biro). The former will be built by Southern African Shipyards to a VARD design that has been adapted to incorporate a flight deck and hangar, making it a more useful ship overall. The IPVs are 62 m 'axe bow' vessels to be built by Damen Shipyards Cape Town. The intention is to acquire an additional three IPVs later, but this will almost certainly have to be deferred.

The outcome of Project Biro is something of a mixed success for the navy, as the ships it really needs urgently, the planned offsho-

re patrol vessels, were deferred. This seems to have been the result of disagreements around Denel wishing to push a Chinese design that did not meet the requirement, linked to an agreement with a Chinese company to partner it to manage the Naval Dockyard in Simon's Town. The concept of a foreign company being involved in the dockyard and having the run of the Simon's Town naval base, was also not well received by the navy, and the decision to transfer the dockyard from Armscor to Denel has been rescinded. It will remain with Armscor to manage on behalf of the navy, and Armscor is developing plans to rejuvenate the dockyard and to find ways of bringing revenue-generating work into the facility.

Photo: via author

UMKHONTO launch from a South African Navy frigate

The navy's other two major projects are the spiral upgrades of the four MEKO A200 frigates and the three Type 209 submarines. Both, however, are likely to have to be stretched out very considerably to fit the funding available.

Thus, it seems unlikely that the frigates will receive a new main radar to replace the Thales MRR, or any new systems other than perhaps the planned close-in surveillance system and additional close-in weapons – each has two Reutech SEA ROGUE remotely-operated 12.7mm mountings and two hand-operated 20mm cannon. The focus will instead be on finding the funds to refit the three ships that have not yet undergone refit and to keep them operational in their current configuration.

Looking forward, there are plans to fit the frigates with a new main radar, enhanced electronic warfare capability, variable depth sonar, lightweight torpedoes, the radar-guided and extended-range UIMKHONTO SAM, new anti-ship missiles, AHEAD ammunition for the twin 35mm dual-purpose gun, and new cannon to replace the old 20mm cannon in the bridge wings. The original intention to replace the 76mm with a 127mm or 155mm gun seems to have been dropped on cost grounds. The embarked SUPER LYNX helicopters are intended to receive missiles (probably the Denel Dynamics MOKOPA) and lightweight torpedoes as well as a dipping sonar and additional electronic warfare capability. There is also a requirement for at least two additional SUPER LYNX helicopters to supplement the four currently available for the frigates.

The submarines too are unlikely to receive major new systems for the time being. One has been refitted, and the Navy will try to refit the other two as funding allows. They may receive new heavy-weight torpedoes, the acquisition of which was approved in 2017. The remainder of their spiral upgrade – which was intended to include a tube-launched missile and a towed array sonar, will have to await less straitened financial times.

The acquisition of three offshore patrol vessels of roughly 90 m – against a requirement of at least eight – remains a priority and that part of Project Biro is being reviewed with an eye to a separate tender once funding becomes available. The government's strong focus on the 'oceans economy' (Project Phakisa) suggests that this may not be as far into the future as some fear, given the need for effective patrol capability. They will supplement the frigates, patrolling the outer edge of the Exclusive Economic Zone, taking over some Mozambique Channel patrols, and patrolling the waters of Prince Edward and Marion islands 1,750 km SSE of the mainland. There is also an intention to begin patrols in West African waters to deter any southward move by pirate groups, and that will require additional vessels. Once the OPV project restarts, there will be a requirement for additional shipboard helicopters, which would be acquired by the air force.

The navy has also begun initial planning for the replacement of the combat support ship SAS DRAKENSBERG, which was launched in 1986 and commissioned in 1987. In fact, there is an understanding that the requirement is for two ships to support operations in conjunction with the few larger navies of the continent. The previous intention to acquire landing platforms for regional tasks is on the back burner and likely to remain there for some time, although there is the concept of an interim solution in the form of chartered Ro-Ro ships that might become feasible earlier.

Smaller projects include off-board mine-countermeasures equipment, to be employed from the IPVs and future OPVs as required, and various small craft.

Air Force Projects

The only major project in hand for the Air Force is the acquisition of the A-DARTER short-range air-to-air missile to arm the GRIPEN and perhaps the HAWK. The first training rounds have been delivered with the first war-shot rounds to follow. Some thought has been given to integrating the A-DARTER with the ROOIVALK attack helicopter, to give it enhanced anti-helicopter capability and self-defence capability against fighters, but that will only be some time in the future.

There is a greater likelihood of the 10,000-metre-range MOKOPA missile being acquired for the ROOIVALK, as it is in production for export and the ROOIVALK is involved in combat operations as part of the UN peace enforcement mission in the Democratic Republic of Congo. It would also make sense to integrate it with the SUPER LYNX embarked on the frigates, as it has already been integrated with the essentially similar SUPER LYNX of the Algerian Navy. Similarly, the UMBANI guided bomb system is in production in the United Arab Emirates and qualified on the Air Force's HAWKs, and so could be acquired for them given some minor funding. It is yet to be qualified on the GRIPEN, for which the air force acquired some PAVEWAY kits several years ago. Despite tight funding, money has apparently been allocated to requalify the ejection seats of the GRIPEN and HAWK for female aircrew falling outside the normal size/weight parameters of the seats.

Photo: via author

The turreted variant of Denel's long-range 105mm gun during firing trials from a US Army LAV platform

More positively, there is still technology funding to continue the development of a new beyond-visual-range missile under Project Marlin, with which Denel Dynamics has carried out the first guided flights. This missile is intended to arm the GRIPEN, and much of its technology will also be shared with the radar-guided version of the UMKHONTO SAM.
A portion of the Oryx transport helicopter fleet has received a midlife avionics upgrade, as has a portion of the PC-7 Mk 2 primary trainer fleet. Denel Dynamics also received an order some years ago for several SEEKER 400 UAVs for Defence Intelligence, but no further information has become available and it is also not clear whether they are being operated by Intelligence or by the Air Force on their behalf.
A project that has been deferred for some time is the acquisition of new radars, with the initial focus on air base radars before the project moves onto supplementing and then replacing the static Plessey AR3D and mobile Marconi TMR radars. This set of projects was expected to go ahead soon, given the growing attention paid to border security, but funding cuts have forced it to be moved to the right yet again. It might, however, be funded sooner than some expect, as South Africa has little idea of what flies across most of its land borders, the static radar coverage being largely limited to the northern and north-eastern border areas. The acquisition of airborne radar systems remains a goal but has not been funded.
Looking forward, there are urgent major requirements in the maritime and airlift spheres, with present capabilities falling far short of what is needed.
The air force is currently flying a dwindling number of 1943 vintage C-47TPs in the maritime surveillance role, which are clearly well past their prime, and which have no optronic sensors and make do with a weather radar. The challenge here is that apart from the mainland EEZ and the Mozambique Channel, which could be covered by a light twin-engine maritime surveillance aircraft, there are also the island waters to be monitored and there is the South African Search and Rescue region (SASAR) commitment that covers vast areas of the South Atlantic, Southern Ocean and Indian Ocean. Both require a long-range/high-endurance type, with the maritime variant of the C-130 seeming to offer the best range/endurance potential. There is a project for the acquisition of maritime patrol aircraft that will supposedly be initiated in the current MTEF, although the Air Force's capital funding seems rather low for this acquisition. The simpler maritime surveillance aircraft project was cancelled for reasons that remain unclear.
The airlift component centres on nine C-130s, seven of them acquired in 1963 and the others slightly younger ex-USAF aircraft, of which there are rarely more than four operational, a few C-47TPs and three CASA 212s that are also now ageing. The Project Continent to acquire A400Ms was cancelled some years ago, leaving the Air Force with no immediate solution. If it is to conduct regional missions, there is a limited choice of aircraft, with only the A400M and An-70 offering the required combination of payload, range and practical ability to operate out of semi-prepared airfields. There is a project to acquire new light transports and that is said to be included in the present MTEF planning, with the choice apparently being between the C-295 favoured by some in the air force, and the C-27J favoured by the main 'airlift clients': the South African Army and Special Forces.
Another key gap is the lack of a tanker to enable the GRIPENs to deploy rapidly into the region if required – as was the case in March 2013 when a contingent in the Central African Republic was at serious risk. A flight of four GRIPENs deployed to Kinshasa in the Democratic Republic of the Congo via Ndola in Zambia, which cost time and might on another occasion not be viable.
The light utility fleet of CARAVANs and KING AIRs has been partly grounded for some time for lack of the funds to renew maintenance contracts. That problem has also effectively grounded the VIP squadron's Boeing BBJ, FALCONs and CITATIONs. The FALCONs and CITATIONs are due to be replaced and there is a government requirement for a long-range VIP aircraft to complement or replace the BBJ, but funding remains a problem.
Looking forward, the air force has begun to consider options for an ORYX replacement, and there is real interest within the air force and army, and among some other air forces, in further development of the ROOIVALK attack helicopter as a Mk2 version.

Other Projects

Defence Intelligence has begun with the development of a cyber operations capability, but the project has been slowed down by the lack of adequate funding. The Military Health Service is currently focused on refurbishing its three hospitals and other facilities, recently refurbished some SAMIL-20 ambulances and is receiving LAND CRUISER and BADGER based ambulances as part of those two army projects. ■

Surviving the Blast

MRAPs and Lessons Learned from the Mine and IED Threat

John Antal

Mines and IEDs kill and wound more soldiers on today's battlefields than any other weapon. Armoured vehicle designers have therefore drawn important lessons for the development of Armoured Fighting Vehicles (AFVs) concerning crew survivability.

Technology changes warfare. In the past 17 years of war, the US and its NATO allies have been fighting against the never-ending threat from mines and Improvised Explosive Devices (IEDs). If this threat was from mechanically activated mines and IEDs, much like the pressure or tilt-rod mines of WWII and the Cold War, the legacy set of equipment developed in the late 20th century could have handled the challenge. As it was, the exponential commercial development of mobile communications and the miniaturisation of components that occurred in the past 20 years has created a perfect blast storm that made most of the deployed military systems vulnerable. The result was a rush to retrain soldiers to deal with the threat and then a heroic effort to enhance vehicle protection. Vehicle protection was upgraded primarily by adding more steel to existing vehicles, then by fielding special Mine Resistant Ambush Protected vehicles (MRAPs), and also by adding electronic systems to find and jam command-detonated mines and IEDs.

New threats are emerging as the US and NATO focus on challenges from near-peer competitors. As armies consider how to develop the next generation of combat vehicles, the lessons of the past two decades are being assimilated. Armoured vehicle designers understand that mines and IEDs kill and wound more soldiers on today's battlefields than any other weapon. They also know that the development and employment of MRAPs on the battlefields of Iraq and Afghanistan have generated significant lessons learned with regard to crew survivability for Armoured Fighting Vehicle (AFV) design. As the US and NATO contemplate the development of the next generation of combat vehicles, these lessons are being incorporated into new designs. Let's review some of the best armoured vehicles to see how the mine and IED threats are being addressed.

Photo: US Department of Defense

A US Army paratrooper takes cover from behind a MAXXPRO MRAP as he fires his M4 carbine at insurgents during a firefight in Afghanistan's Ghazni province, 30 June 2012. MRAPs address the threat of mines and IEDs in combat in Iraq and Afghanistan.

Author

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MRAPs

Cougar

The US military spent nearly US$50Bn to quickly field 29,000 MRAPs for service in Afghanistan, Iraq and Syria. The advanced ballistic and blast-protected COUGAR provided much of that capability. The COUGAR MRAP is touted as the most survivable MRAP on the market. It is produced by General Dynamics Land Systems. The COUGAR comes in two main configurations: Category I (4x4 wheel) and II (6x6 wheel) versions. The COUGAR 4x4 can transport 6 soldiers while the COUGAR 6x6 can seat 10 combat-equipped soldiers. The COUGAR's anti-mine, anti-IED capabilities are significant and include a "V" shaped hull; the ability to add side armour to inhibit mine and RPG attacks; ballistic glass to provide vision for troops to see and engage enemies through the gun ports in the glass while not exposing themselves to fire; multi-point, racing style harnesses to allow crewmembers to better survive a roll-over; internal fire extinguisher systems; and the ability to support electronic countermeasures including

the AN/VLQ-12 CREW DUKE V3 counter remote-controlled IED (RCIED) electronic warfare system, which neutralises electronically activated, remote-controlled road-side bombs and IED attacks.

MAXXPRO

The MAXXPRO MRAP was designed by International Truck, Navistar Defense, in cooperation with the Israeli Plasan Sasa, who designed the state-of-the-art lightweight ballistic protection and survivability armour. MAXXPRO can survive a 7 kg (15 lb) land mine blast without any injuries. The MAXXPRO's anti-mine, anti-IED capabilities are significant and include ballistic glass protection; roll-over harnesses; add-on armour capability; and can support counter RCIED electronic jammers. The MAXXPRO comes in two categories: the MAXXPRO Dash (Category 1) and the MAXPRO Plus (Category 2). The MAXXPRO has a V-shaped hull and a two-piece design that adds to crew and vehicle survivability. To date, Navistar has produced seven MAXXPRO variants under contract: the original MAXXPRO, MAXXPRO Air Force, the MAXXPRO Plus with improved protection, MAXXPRO ambulance (production orders were for the Dash variant), MAXXPRO MEAP (MRAP Expedient Armor Program), the MAXXPRO Dash for Afghan operations, and the MAXXPRO Recovery Vehicle (MRV), for recovering stuck vehicles. The firm has also developed a cargo flatbed and tractor (18-wheeler truck's front end, but with mine protection) variants. The MAXXPRO's "V" shaped hull "does a very good job of redirecting energy," reported Bob Walsh, the Vice President and General Manager of Navistar Defense, LLC. Walsh also remar-

Photo: Spc. Elisabeth Freeburg / US Army

The M-ATV (Mine-Resistant, Ambush-Protected All-Terrain Vehicle), built specifically for the mountainous Afghan terrain, parks next to the larger MAXXPRO DASH MRAP. The first M-ATVs designated for Afghanistan arrived at Kandahar Airfield by air transport on 22 October 2009.

ked that the MAXXPRO is easier to repair than many other MRAPs: "Being cab-on-chassis, you're able to pull off this body and slide a new chassis in." In September 2017, Navistar Defense was awarded a US$29.6M federal contract by the US Army Contracting Command for system sustainment and technical support services for the in-production and out-of-production Mine Resistant Ambush Protected MAXXPRO family of vehicles.

L-ATV (Light Combat Tactical All-Terrain Vehicle)

In spite of their success, many MRAPs are often criticised for their size and lack of manoeuvrability. Recognising the need to protect from mines and IEDs, the US military needed a wheeled vehicle built like a tank, but with lower weight and greater manoeuvrability that could run like a HMMWV. The answer was the L-ATV (Light Combat Tactical All-Terrain Vehicle) by Oshkosh. In 2015, the US military selected Oshkosh to produce the L-ATV. This vehicle carries four combat-equipped soldiers, has improved mobility and protection, including blast protected seats for the crew. According to Oshkosh: "The L-ATV's armoured capsule is scalable and can accept multiple armour configurations to protect troops from IEDs and today's other prevalent battlefield threats. The capsule is optimised for protection, weight and mobility, and its modular and flexible design allows the vehicle to accept a greater range of upgrades and continuous enhancements. The protection system can withstand underbelly blasts. The L-ATV can accept add-on armour packages and a host of counter RCIED electronic systems to operate according to the mission requirements." The basic L-ATV has no armament, but the vehicle can be fitted with a wide array of machine guns, grenade launchers, and smoke dispensers. Oshkosh was awarded a US$6.75Bn low rate initial base contract with eight option years to procure the first 16,901 vehicles for both the army and Marines. According to the study "Joint Light Tactical Vehicle (JLTV): Background and Issues for Congress, by Andrew Feickert", the Oshkosh L-ATV "offers protection levels greater than those of up-armoured HMMWVs and comparable to those of original MRAP class designs, but in an overall vehicle package that is considerably smaller and lighter than vehicles procured under the US Marines MRAP procurement."

Wescom Defence's Portable Explosives Minefield Breaching Systems (PEMBS)

(ck) Unconventionally deployed mines, booby-traps, unexploded ordnance and man-made obstacles are designed to bring military operations to a standstill. Portable Explosive Mine Field Breaching Systems (PEMBS) are designed to mitigate these threats and are an effective means to safely eliminate them. PEMBS are also used for humanitarian de-mining.

A minefield is designed to create an obstacle which will take out the momentum of movements of military forces. To maintain the advancement of troops and avoid rerouting the troops to a position that could favour the enemy forces, a fast and effective way to overcome minefields is essential in combat.

Wescom Defence's Portable Explosives Minefield Breaching Systems (PEMBS) offer a quick and effective way to safely eliminate deployed land-mines as well as man-made obstacles, such as triple barbed wire. These systems are categorised into Heavy Portable Systems, Light Portable Systems and Heavy Duty Portable Systems.

PEMBS feature a detonating cord with a package of explosives contained in either one or two rucksacks which is deployed across the chosen area by means of a rocket. Products from WesCom include the Heavy Portable Explosive Minefield Breaching System (H-PEMBS), which features a rocket projected detonating cord, attached to containers filled with high explosives. The detonation creates a clearly visible path (approx. 55 metres) through a minefield. There is a Light Portable Explosive Minefield Breaching System (L-PEMBS) alternative, which leaves a footpath of approximately 74 metres after detonation and a Heavy Duty version – the Heavy Duty Portable Minefield Breaching System – which is manufactured with a rocket projected detonating cord, designed like a rope ladder. For this product, metal tubes are filled with highly explosive material and after detonation form a path up to 80 metres wide through the minefield.

Ongoing training is essential for effective use. WesCom Defence offers a selection of appropriate training products, including the Training Heavy Portable Minefield Breaching System (THPEMBS), which can be re-used several times in practice. A version of the lightweight portable system is also available as a training system - the Training Light Portable Minefield Breaching System (TLPEMBS) - and a Training Heavy Duty Portable Minefield Breaching System MRL80.

The portability and the simplicity and effectiveness of these systems make PEMBS a suitable tactical solution for major battlefield threats.

WesCom Defence, part of WesCom Signal and Rescue, is a world-renowned specialist in pyrotechnic products for signalling, illumination, training and simulation. Thanks to the company's experience and extensive production capacities, WesCom Defence can develop tailor-made pyrotechnic products for the defence industry based on the latest developments in pyrotechnic technology. For more information about WesCom Defence, to see the full range of products and product capabilities, or to contact the company, please visit: **www.wescomdefence.com**

Infantry Fighting Vehicles (IFV)

T-15 ARMATA BMP

Russian developers at Uralvagonzavod have taken notice of the counter-mine and counter-IED strengths of MRAPs and, using their previous experiences in Afghanistan and Chechnya, are building new capabilities into their advanced IFV designs. The T-15 BMP (Боевая Машина Пехоты, or BMP, stands for IFV) uses the same chassis as the T-14 ARMATA Main Battle Tank. It is expected to replace the BMP-2 IFV and MT-LB Armoured Personnel Carrier (APC) in the Russian Army. The T-15's engine is located in the front of the hull to allow an infantry squad to be carried under armoured protection in the back of the vehicle. The T-15 BMP three-man crew sits in a protective capsule in the hull behind the engine, but forward of the remote-controlled turret. The T-15 includes the Malakhit dual-layered reactive armour and active and passive protection systems, and special paint to reduce its infrared signature and provide enhanced stealth. The T-15 also includes a reinforced hull for counter-mine and counter-IED protection as well as an electronic jamming system to neutralise radio-controlled anti-tank mines and command detonated IEDs.

NAMER Heavy APC and IFV

The NAMER is an Israeli Ordnance Corps-made Heavy APC that is based on the MERKAVA 4 Main Battle Tank chassis. Developed in 2008, the NAMER is a major part of the Israel Defence Force's (IDF) modernisation plan and saw combat with the Golani Brigade during the 2014 Gaza conflict. In Hebrew, NAMER means Leopard and also serves as an abbreviation for "Nagmash" (APC) and "Merkava" (Tank). The NAMER weighs 60 tonnes

Photo: Ishaiabigail

The NAMER is an Israeli-made armoured fighting vehicle based on the MERKAVA tank chassis that is used by the Israeli Defence Forces. In 2012, the NAMER was tested by the US Army at the Maneuver Battle Lab's Ground Combat Vehicle assessment at Fort Bliss, Texas.

and has a crew of three positioned in the hull. The NAMER can be equipped with a number of different automated turret systems, and in 2017 the Israeli Defence Ministry unveiled an IFV version fitted with an unmanned turret armed with a 30mm cannon and the ASPRO-A TROPHY Active Protective System (APS) to defeat incoming projectiles. The combat-proven TROPHY APS, developed by Rafael Advanced Defense Systems Ltd., provides all-around coverage against RPGs, anti-tank missiles and tank HEAT (high-explosive anti-tank) rounds. Once the TROPHY system detects a threat, it automatically tracks, classifies the threat, determines the best intercept point, and then launches a countermeasure. The Israeli-made 4th-generation SPIKE tandem warhead anti-tank missile can also be added for the IFV configuration. The NAMER has a specially designed V-hull belly armour pack and electronic counter-mine and counter-IED systems can also be added. In 2012, the US Army considered the NAMER for the Ground Combat Vehicle (GCV) programme and tested the vehicle at Fort Bliss, Texas, but the GCV programme was cancelled in 2014. Undaunted, the Israelis continue to praise the NAMER and in 2015, Israel's MoD stated: "The NAMER is considered to be the most protected armoured combat vehicle in the world, which proved its abilities during fighting in Operation Protective Edge against many threats."

KF41 LYNX IFV

The Rheinmetall LYNX KF41 (KF stands for "Kettenfahrzeug", or tracked vehicle in German) is a German-made next-generation family of vehicles that offers state-of-the-art firepower, mobility and protection. The LYNX consists of a modular design that comes in two primary versions: the KF31 and KF41. Both versions have a driver in the hull and a two-man crew in the turret. The engine is in the front and the exhaust in the rear. Weighing up to 38 tonnes, LYNX KF31 can seat 3+6 soldiers. LYNX KF41 is slightly larger and can carry 3+8 soldiers. Rheinmetall's LANCE turret for the KF41can support a 30mm or 35mm cannon and the turret ammunition is separated from the crew for added protection. Both versions can be configured for IFV, C2 (command and control), reconnaissance, repair and recovery, and ambulance variants. The vehicle interior has a spall liner, decoupled seats, and mine and IED protection packages that can be exchanged in the field. The KF41 does not have a V shaped hull, but its mine protection is highly effective against heavy blast mines, explosively formed projectile mines and IEDs. The KF41 also has passive and reactive systems to defeat rocket-propelled grenades and antitank guided missiles and provides roof protection against cluster munitions. Rheinmetall's SOLAR SIGMA Shield Mobile Camouflage System can also be fitted to the entire vehicle to reduce heat loading as well as thermal and IR signatures.

Main Battle Tanks

T-14 ARMATA

The latest Russian-made tank, the T-14 ARMATA (Армата), is an innovative, fifth-generation, main battle tank that represents a technological leap in manned-tank design. The ARMATA's weaponry and armour have been maximised for open combat, and much of its new technology is truly impressive. It appears that the Russians have taken the mine and IED threat seriously in the design of the T-14. The tank is modular and divided into three compartments: a forward crew area; a remote-controlled unmanned-turret positioned on top of the hull configured with a 125mm 2A82-1M smoothbore cannon with a 45-round automatic loader; and the engine is at the rear of the tank. The three-man crew sits in an armoured capsule composed of the equivalent of 900 mm of Rolled Homogeneous Armour (RHA). The tank's millimetre-wave radar and Active Protection System (APS) empower the ARMATA to automatically detect, track, and intercept incoming kinetic and tandem anti-tank munitions. Unlike legacy tanks in the NATO armies, stealth technology has been built into the design to generate reduced visibility and "dynamic signature changes" in the radio, infrared, and magnetic bands. This feature is reported to inhibit recognition of the tank's systems. Russian Uralvagonzavod officials, who built the tank, claim that the ARMATA is "invisible to radar and infrared detection due to radar-absorbing paint and the placement of components with heat signatures deep within the hull." The tank is also capable of generating a multispectral smoke screen in the infrared and millimetre wavelengths to conceal the tank from enemy weapons. These capabilities combine to hide the ARMATA and could inhibit targeting and the timing of command-detonated mines and IEDs. To compensate for the flat hull, the ARMATA has additional armour plate in the hull for counter-mine and counter-IED protection. Although untested in combat and with fewer than 100 systems to be deployed to the Russian Army by 2020, the ARMATA appears to be a formidable next-generation tank design that NATO armies can learn from to develop their own next-generation combat vehicles.

M1A2 SEPV3

The M1 ABRAMS Main Battle Tank has been the cornerstone of the US Army and US Marine Corps' ability to fight combined arms warfare since the early 1980s. The US Army deployed M1 Tanks to Iraq, but not to Afghanistan. The US Marines used M1 Tanks in both Iraq and Afghanistan. In Iraq and Afghanistan several M1 Tanks were disabled due to mines or IEDs.
To counter the mine threat, a variant of the M1 Tank, the M1150 Assault Breacher Vehicle (ABV), nicknamed "SHREDDER", was developed as a mine- and explosives-clearing vehicle and equipped with a mine-plough and explosive line charges. The US Marines used the M1150 SHREDDER in Southern Afghanistan in 2010 with great success. In 2013, the US Army deployed six SHREDDERs to Korea to the 2d Infantry Division, but there are only a handful of these special tanks. The major challenge for the army and Marine Corps is how to upgrade new versions of the M1 to keep the tank fleet relevant in view of the extensive mine and IED threat. The M1A2 SEPV3 (Systems Enhanced Package Version 3) is the answer to this question and the latest adaptation of the M1 series tank. The M1A2 SEPV3 has significant upgrades that include enhanced fire cont-

rol, power generation, and improved crew protection. Learning from mine and IED attacks in Iraq and Afghanistan, the developers of the M1A2 SEPV3 have increased the tank's passive defence by adding a new armour package for the hull and turret. In addition, the M1A2 SEPV3 has the AN/VLQ-12 CREW DUKE V3 counter

Photo: Staff Sgt. Timothy R. Koster / US Army

US Army M-ATV MRAPS at the demarcation line outside Manbij, Syria, in July 2018

remote-controlled IED (RCIED) electronic warfare system. This state-of-the-art jamming technology is the latest version of the RCIED system used on MRAPs in Iraq and Afghanistan and employs an advanced software-defined architecture that supports rapid reconfiguration to adapt to the constantly evolving threat environment. In 2015, the US Army provided US$92.2M to General Dynamics Land Systems to upgrade its M1A2 SEPV2 ABRAMS tanks to the M1A2 SEPV3 configuration. The first ABRAMS M1A2 SEPV3 initial production vehicle was delivered to the US Army in October 2017. Also that October, General Dynamics Land Systems received a US$270M contract from the US Army Tank Automotive Command to manufacture 45 ABRAMS M1A2 SEPV3 tanks. Unit fielding is expected to begin in 2020. "These vehicles are not just about assuring our allies, or deterring or coercing potential adversaries," Maj.Gen. David Bassett, program executive officer for Ground Combat Systems said in an October 2017 interview. "They are about compelling our enemies and winning the multi-domain battle." With these developments it appears that the US military is adapting its legacy M1 tanks with the lessons of mine and IED combat in Iraq and Afghanistan in mind.

LEOPARD 2

The German built LEOPARD 2 Main Battle Tank was produced in the 1970s by Krauss-Maffei, now Krauss-Maffei Wegmann (KMW), of Munich, Germany. KMW developed a mine-protected tank version in July 2004 with a kit that consists of add-on armour that includes a new armoured plate to reinforce the hull against mines and IEDs. Tests conducted in February 2004 demonstrated that the new LEOPARD 2 armour package successfully protected the tank crew from the detonation of an anti-tank mine under the tank. A small number of LEOPARD 2 A4Ms were deployed by Canadian, Danish, and German NATO forces to Afghanistan with success. Several of these LEOPARD 2s were damaged by mines and IEDSs but were repaired. The greatest shock to the LEOPARD's counter-mine and counter-IED reputation occurred in 2016, when 10 Turkish Army LEOPARD 2A4 Tanks (older export versions without some of the countermine upgrades) were destroyed in combat during Operation Euphrates Shield. The Turkish LEOPARD tanks were ambushed by ISIS fighters using a combination of mines, IEDs and anti-tank missiles at al-Bab, in northwest Syria. ISIS took photos of the destruction and posted them to their social media sites to brag about the destruction of Germany's "best" tank. To address this challenge and upgrade the tank for use by the Bundeswehr, Rheinmetall has produced a new LEOPARD 2A7V configuration (V stands for improved). The LEOPARD 2A7V has new state-of-the-art capabilities to meet emerging threats in Europe and includes upgraded protection to address the mine and IED challenge. The LEOPARD 2A7V model is equipped with a modular protection kit with passive armour modules to provide 360° protection to the crew from anti-tank missiles, rocket-propelled grenades (RPGs) and reinforced hull shielding to protect against mines and IEDs. In September 2017, Rheinmetall was awarded €118M to upgrade 104 LEOPARD 2s for the Bundeswehr to LEOPARD 2A7Vs. The new LEOPARD 2A7V will enter service between 2019 and 2023.

Attack from below is only part of the problem to countering mines and IEDs. Attack from the top is the next big challenge to address in the development of Next Generation Combat Vehicles. For example, the Russian military is developing a top-attack antitank mine designated as the PTKM-1R. The PTKM-1R mine is a green cylinder the size of a fire extinguisher that weighs close to 20 kg and is designed, according to the Russians, to create an impenetrable minefield. The PTKM-1R is similar to the US Textron Defense Systems M93 HORNET Wide Area Munition (WAM) and represents the new capability of top-attack smart mines.

Conclusion

Surviving the blast has become a prerequisite for next-generation armoured vehicle design and should not be considered just a special case for counterinsurgency (COIN) operations. MRAPs have saved many lives, but they are predominantly wheeled vehicles and primarily defensive. Modern armies will not employ MRAPs as they do tanks and IFVs in combined arms combat against a peer-adversary. MRAPs are only armoured trucks that have limited offensive capability for high-intensity operations. As heavily armoured troop carriers, MRAPs do not meet the requirements of the new mission set emerging in Europe and Asia. As new, smarter mines are developed – consider the development of the Russian top-attack smart anti-vehicle mine PTKM-1R – the ability to counter the mine and IED threat becomes even more important. Most legacy AFVs are not designed with robust active or passive counter-mine or counter-IED capabilities. Reinforcing existing hulls with new materials such as the new "Super Bainite" steel may provide a solution for legacy vehicles, but the cost of new materials technology and the simple physics of armour versus counter-armour makes a "silver bullet" solution unlikely. Passive and active counter-mine and counter-IED systems, as well as stealth, should be considered as an integral part of next generation combat vehicles. Armoured vehicles have a long shelf-life as few militaries can afford to start over with totally new systems. The design of the next generation of combat vehicles, either manned or unmanned, must incorporate the lessons learned from the past 17 years if vehicles and crew members are to survive the blast. ■

Countering IEDs

New Developments or More of the Same?

Dan Kaszeta

IEDs are usually a cheap and primitive threat, but that's why they're dangerous, because they are widespread and can be manufactured and planted quickly. There is a range of countermeasures from very low to very high technology. For every high-tech widget in the Counter-IED box there is a torch, a shovel and a wheelbarrow that are probably just as useful.

Threats from improvised explosive devices (IEDs) are not a new phenomenon. They have existed in one form or another since the advent of gunpowder. Indeed, the UK has an unofficial holiday (Guy Fawkes Day), which commemorates an unsuccessful IED incident in 1605. The various post 9/11 conflicts, principally but not exclusively the wars in Iraq, Afghanistan, Syria, and Yemen have seen large numbers of IEDs used in asymmetric warfare against both military and civilian targets. IED casualties have been an important factor in these conflicts. International and domestic terrorists make frequent use of IEDs to further extremist agendas. Consequently, governments have spent large amounts of money to counter the IED threat.

Counter-IED Operations

Counter-IED (C-IED) operations include a broad range of disciplines, including search operations, intelligence, combat engineering, and explosive ordnance disposal (EOD), to name only a few. Also, C-IED is related to, but distinct from, traditional countermining operations (mines are not improvised) and disposal of ordnance that did not function (these are malfunctions, not intended devices). Many of the products and technologies from one discipline are used by the other.

However, mine warfare and demining are somewhat beyond the scope of this article. The threat from IEDs can be described as a largely low-technology threat which is combated with a spectrum of countermeasures ranging from very low technology to very high technology. Much of the defence media world obviously focuses on the high technology products now available, but much of the counter-IED world is basically low-tech. For every high-tech widget in the EOD team's truck, there is a flashlight, a shovel, and a wheelbarrow, which likely get at least as much use. So, therefore, the role of simple everyday items in counter-IED work should not be forgotten. However, this article seeks to provide an overview of new developments in the field.

Author

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Philosophy

An overarching development has been the evolution of a philosophical framework. Finally, one important development has been philosophical. The major western militaries and their security services now tend to look at the IED threat as a system. The use of IEDs involves a variety of activities ranging from procurement of materials and production of devices, through reconnaissance and target selection, placement, and detonation of the device. A comprehensive counter-IED strategy looks at every part of this operational cycle or system and plots to disrupt any plotted use of IEDs.

A large part of the effort to disrupt, deter, or prevent IED employment, across the full "system" involves intelligence efforts, traditional security disciplines, diplomacy, and law enforcement. These efforts occur, by necessity, well before the construction and emplacement of devices. While much of this work is, by necessity, very sensitive, a number of tools and products are marketed to aid these activities. Numerous software tools are aimed towards the C-IED market. Indeed, these are too many to mention. Some are proprietary tools developed within government organisations. Commercial products are available as well. One that keeps appearing in the European space is iThink, a product by Indra (Spain). Also of note are information-sharing efforts such as the EU's Bomb Data System, which is funded by member states specifically for sharing information on IEDs.

Electronic Countermeasures

IEDs need some mechanism to cause them to function. A wide variety of means have been used to set off IEDs, including radio communications (especially mobile phones), wire, timing, and various types of sensors ranging from crude booby-traps to sophisticated repurposing of intrusion detection technology. An entire discipline of electronic countermeasures has arisen around the overall goal of disrupting the radio communication used to detonate an IED. A typical device might include a mobile phone or something less sophisticated such as a

Photo: Harris

The Harris CREW Vehicle Receiver/Jammer (CVRJs) is a vehicle-mounted electronic jammer designed to prevent the detonation of IEDs, which are often triggered by off-the-shelf technology like mobile phones. CVRJ counters existing and evolving Radio Frequency (RF) threats by jamming transmitted RF signals.

remote control toy as the primary means of detonation. A large variety of techniques can be used, ranging from very crude jamming of large swathes of the radio spectrum to extremely sophisticated specialist methods. Myriad products in this space exist, largely but not completely for use in military operations. Two large programmes of particular interest in the electronic countermeasures (ECM) space are worthy of specific mention. The Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (JCREW) is a very large US Navy-led programme to develop and procure the latest generation of smart jamming technology. The prime contractor is Northrop Grumman, and the expected overall programme value of the various contracts may exceed US$500M. There is a dismounted version for use with soldiers and marines, a vehicle-mounted edition, and systems for fixed site use. Several generations of JCREW equipment have served long and hard in places like Afghanistan and Iraq.

An Australian effort in this ECM arena is something called the SILVERSHIELD programme, with L3 Micreo. SILVERSHIELD is intended for vehicle-mounted use against IEDs using mobile phones. Approximately 13,000 systems are being provided to Afghanistan for use in force protection for military and police users. This particular system is part of a broader programme called REDWING, which has fielded systems such as the GREYGUM for use on light vehicles and the GREENGUM for use by soldiers on foot.

Photo: L3 Micreo

L3 Micreo's SILVERSHIELD is intended for vehicle-mounted use against IEDs using mobile phones.

Detection: Point and Standoff

Not every device can be interrupted by ECM. Devices initiated by a command wire or by means such as sensors and pressure plates are still difficult to counteract. There is a distinct and persistent operational requirement for the detection of IEDs. However, detecting IEDs from a safe distance is still quite difficult. Numerous techniques are available for point detection of explosives, such as trace detection, manual search techniques, and the use of detection dogs. While there are incremental improvements in this area, radical new developments in these established techniques are few at this time.

It is worth examining X-ray detection technologies as useful technologies for the detection of IEDs. The use of x-ray systems for detection of objects in containers and baggage has been ubiquitous for many decades now, and still has a place in the detection of IEDs. Smaller, more portable systems are used by EOD technicians to examine suspicious devices. Larger systems are in use at ports, borders, and at checkpoints that can scan cars, trucks, cargo containers, and even railway carriages. Companies such as Smiths Detection (UK), AS&E (USA), Rapiscan (USA), L3 (USA), and Scanna (UK) are all leaders in the conventional x-ray space. Of particular interest in recent years has been the advent of x-ray systems that can detect the presence of bulk explosives, obviously of interest in vehicle-borne IED (VBIED) detection. This has led to vehicle-mounted systems that can literally drive down the street, scanning vehicles and looking for the presence of explosive materials. These tend to be lower energy systems, using principles like "backscatter" so they are safer to operate around the public than massive cargo scanning systems that can represent a radiation safety risk.

Photo: QinetiQ

QinetiQ's SPO system enables the operator to scan crowds and search for anomalies without the need to disrupt the flow of foot traffic through the area.

Point detection methods, however, are inherently dangerous, because they involve close proximity to dangerous devices. Detection of possible IEDs at some degree of stand-off distance would be greatly desirable. Effective stand-off detection of IEDs remains a bit of an elusive target for the major militaries of the world, but serious research and development efforts have gone into this area of inquiry.

Systems designed for standoff detection of explosives concealed on a human body, such as suicide bombers, is somewhat easier than stand-off detection of vehicle-borne IEDs (VBIEDs) such as car and truck bombs, or roadside devices of many descriptions. This is because, from a technical perspective, it is far easier to "see" through clothing than, say, a car or truck. Systems that work in the infrared or radar spectrum can sense when someone has some bulk material (like explosives) and/or wiring under their clothing. These systems have been in use for some years, but the operational ranges are both limited and classified. However, distances of perhaps 100 metres or so are certainly feasible. The author did some consulting work on a pro-

Photo: U.S. Army

The DOK-ING MV-4 Mechanical Anti-Personnel Mine Clearing System is used to clear areas infested with land mines. The machine digs and pounds the soil, which results in the detonation or shattering of anti-personnel (AP) mines.

totype system 10 years ago. One current system is the COUNTERBOMBER, a product by the company Rapiscan (USA), and it has seen service with the US military. QinetiQ (UK) has a system called the SPO which uses passive millimetre wave technology. Various versions of the QINETIQ system have been marketed, often for transportation security purposes, for a decade.

A promising technology worth exploring is laser spectroscopy. The basic concept is that lasers can be used at some distance to interrogate objects. The laser light would interact with molecules of explosives (or related molecules of interest such as by-products or precursors) and a sensor would be able to discern this interaction from a distance. Techniques like Raman and FTIR spectroscopy clearly work at very short distances (i.e. centimetres) and are used for a variety of chemical identification applications. However, using lasers at a distance poses a number of challenges, not the least of which is the hazard of setting off a device by shining a laser on it. Also, the wide variety of materials in the environment makes for interesting problems in interpreting signals. However, progress has been made. Some firms, such as Laser Detect Systems (USA/Israel) have fielded products. Advertised range is low, however. Laser Detect System's R-SCAN boasts a range of 30 metres, well within the hazard range of all but the smallest IEDs. However, this is an area where technology is likely to improve. A variety of prototype systems are in the development pipeline and several governments, first and foremost the US Government, are expending resources to fix this capability gap.

It is worth mentioning that IED detection has been plagued by pseudoscience and frauds, resulting in deaths. Various devices, often claiming to use "magnetic resonance" or to be the equivalent of "divining rods" have been appearing on the market periodically for decades. Now discredited trade names like "Sniffex" and "ADE-651" are associated with these scams and frauds. A UK businessman was sentenced to prison for selling discredited products in this field. None has ever been demonstrated to work, nor has any ever been proven to have any functional components with any scientific basis. It is likely not a coincidence that the various large contracts for their procurement happen to occur in countries infamous for corruption in public procurement. However, the fact that there clearly is demand for products that promise a magic solution to a hard problem shows how difficult the IED problem is for some parts of the world.

Robotics: UGVs and UAVs

Remote detection is still in its infancy. There is a need to get close to possible IEDs in order to verify their danger or to render them safe. The time-honoured method for this is to use robotics. There have been interesting developments in either the conventional ground robots, or "unattended ground vehicles" (UGVs) as well as in the aerial drone/UAV space. Small robots have been used for decades for reconnaissance, detection, investigation, and disruption of IEDs. Small and large UAVs do much reconnaissance work in route clearing and scouting for possible IEDs, as well as monitoring suspicious activity that might be IED emplacement.

Small, remote controlled UGVs for C-IED work are numerous and there are dozens, if not hundreds of manufacturers in this space. However, an area where some interesting developments have occurred has been on the larger end of the robotics market. Large UGVs, some the size of trucks, can provide an element of brute force that small robots cannot. Larger systems, such as the DOK-ING (Croatia) series of UGVs, can knock holes in walls, push cars off the road, and clear potential IEDs while the operators

Masthead

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are safely well away from the action. One DOK-ING system, the MV-4, was adopted by the US military as the M160 and has seen much combat in Afghanistan, surviving very large explosions. A company making similar products, MineWolf, faced financial difficulty and their intellectual property was acquired by Pearson (UK).

Disruption

When an IED is found, it can be avoided and bypassed for some time, but often the problem will persist until something is done about it. The neutralisation of IEDs can take many forms. The stereotype of a man in a bomb suit clipping a wire is based on reality, but the true reality is that every other option for disposing of an IED will be considered before putting a highly trained technician at risk. Disablement and disruption techniques range from crude to elegant, but most are significantly low-tech in their approach, such as controlled explosions and the use of disruptors (the early ones were often based on shotguns, or indeed actual shotguns) to attack critical components of the device.
An area where technology comes into the disruption business is the possible use of high-energy lasers. The Australian branch of L3 responded to Australian requirements for C-IED technology by developing the HELA, the high-energy Laser Array. This project appears to still be in the development pipeline, but shows the promise of using lasers to burn through the outer layer of IEDs and disrupt the components. Similar projects are in the development pipeline in the USA and elsewhere.

Forensics

After the discovery, disruption, or use of an IED, there are a range of activities that can exploit the materials recovered from an incident. IED forensics is a growing discipline and both material exploitation of intact or disrupted devices and post-blast investigation after a detonation can provide extensive intelligence information and/or forensic evidence useful in criminal prosecutions. There are technologies and products for the examination of explosive material. Many of these are very similar to those used for detection and identification of chemical warfare agents and hazardous materials, addressed in previous issues of this publication. Both manufactured and homemade explosives leave much evidence of their origin, and this can lead to the networks that procured and made the devices. Other techniques exist for forensic exploitation of electronic components. For example, even a highly damaged mobile phone can reveal interesting information. Further, conventional criminological evidence, such as fingerprints, can be gleaned from fragments and components. To be useful, however, literally dozens of processes and techniques need to be used together.
One excellent example of IED forensics in practice is the French Counter-IED Exploitation Laboratory. This is a combined deployable asset which has everything that technicians could want or need to exploit IEDs or the components thereof. The French lab was demonstrated at NATO headquarters and has deployed to Mali. Indra, the Spanish company, makes entire deployable IED labs for interested customers.

Conclusion

The IED threat is complex and is not amenable to an easy solution. C-IED comprises a bewildering array of low- and high-technology processes and solutions. There is a thriving marketplace serviced by both large defence conglomerates and smaller firms, with some interesting and possibly revolutionary technologies now in use and in the development pipeline. ■

Force Multiplication Options for the Infantry

David Saw

Operational requirements based on experience gained in the field should offer a far better guide to what is truly necessary than requirements based on theoretical studies. Of course that assumes that the right lessons are learned from actual combat operations, something that is not always guaranteed, and that the funding is available to support the acquisition of new equipment and the tactical/technical innovations made necessary by operational experience.

The US and European militaries can now draw on extensive operational experience gained in the crucible of combat in Afghanistan, Iraq, West Africa and other parts of the world. There is no doubt that much has been learned in these conflicts and that this has resulted in significant changes at the operational and tactical levels. However, while combat experience drives change and the acquisition of new or modified equipment, the process of understanding the real lessons learned and of absorbing new equipment is only part of the story.

In many respects the reaction to operational requirements driven by recent combat experience can be characterised as being a process of looking for more performance and effectiveness in a format that is less weight intensive. There is a need for more firepower, but this is not just suppressive firepower; what is needed is more accurate and therefore effective fire. Potentially, this is to be achieved by weapons and ammunition that are lighter than those currently in service with the infantry. Another requirement is for increased protection for the individual soldier, but the key is that this additional protection comes with a reduced weight burden.

Other areas of concern include communications. Here the need is to operate reliably and securely, to be capable of moving ever increasing quantities of voice, data and video communication and again the aim is to reduce the weight burden on the individual soldier. More performance is also wanted from night vision equipment and weapon sights, with reduced weight as a part of the package. Added to this is the need for higher performance batteries capable of delivering higher performance for longer periods and capable of being rapidly recharged and all at a lighter weight than previous generation batteries. The changes driven by operational experience gained since 2001 cover practically every area experienced by the infantry soldier, from combat clothing and boots to combat helmets and beyond.

In principle, all of these positive developments from uniforms and boots, to protection, to weapons and sights, sensors and communications equipment should have increased the combat power of the infantry. In theory this is correct, but in reality things are very, very different. All of these expanded capabilities come with a cost and that cost is in increased weight. In Dismounted Close Combat environments the increased weight burden that the infantry is expected to carry reduces their mobility and in turn that reduces tactical flexibility and can increase their vulnerability. The other aspect of increased soldier loads is the prevalence of orthopaedic or musculoskeletal injuries. There is very little point in providing your soldiers with all of this wonderful equipment if utilising it will put them on the injured list. Furthermore, these injuries can have long-term consequences with the potential to force early retirement.

Carrying the Load

The scope of the problem of injuries as they impact the US Army was revealed during testimony by General Mark A. Milley, US Army Chief of Staff, in testimony to the Senate Armed Services Committee on 25 May 2017. General Milley noted that while recruitment and retention goals were being met, the problem was that readiness was not at the levels required, predominantly due to manning issues. At the root of this readiness/manning problem is the number of non-deployable troops in the US Army.

Although General Milley did not disclose the full extent of the non-deployable problem in the US Army, in questioning by Sen-

Photo: Sergeant Joseph R. Chenelly, U.S. Marine Corps

US Marines in Afghanistan during Operation Enduring Freedom in November 2001. The amount of weight the individual soldier was carrying had grown to such an extent that operational effectiveness was lost due to fatigue and load-derived injuries.

ator Jack Reed (Democrat, Rhode Island) some more facts came to light. Senator Reed said that: "I understand 10% of the non-deployable personnel are non-deployable for medical reasons?" In response General Milley stated that: "About 85% to 90% are medical, the rest of them are legal or other reasons." The Senator then enquired whether the medical causes of the high non-deployable rate were due to enhanced training, lifestyle or other factors? General Milley responded: "The majority (of those medical causes) are orthopaedic-type injuries. Most are recoverable with some extended profiles. So they are non-deployable in the short-term. Total Army, out of the one million-plus troops, about 20,000, two percent or so, are hard down. They will never be able to deploy. And those we are working through the Integrated Disability Evaluation System (IDES) system." (Note: IDES is the precursor to the soldier being released from the military and their care handed over to the Veteran's Administration).

The loss of 20,000 trained personnel is an extraordinary number to be dealing with and the US Army is taking steps to reduce the numbers of non-deployable troops caused by medical problems. This process is helped by the fact that high-intensity combat deployments are fewer than previously, meaning fewer medical injuries. However, it is worth noting that US Army readiness is far lower than it needs to be. As recruitment targets are being met, the objective is to fill out the current force structure and then use this as a basis for expanding the size of the force in the future.

Apart from restoring its numbers, the US Army has also developed a number of modernisation priorities. General Milley and then Acting Secretary of the Army Ryan D. McCarthy issued a document called "Modernisation Priorities for the United States Army" in October 2017. Amongst the listed priorities was 'soldier lethality'.The document described this as: "Soldier lethality that spans all fundamentals – shooting, moving, communicating, protecting and sustaining. We will field not only next-generation individual and squad combat weapons, but also improved body armour, sensors, radios, and load-bearing exoskeletons."

Photo: U.S. Marine Corps

Marines in the Infantry Officer Course during a live fire exercise at the Twentynine Palms training area. The US Marines conducted a study on soldier loads in combat and discovered that the assault load of a Marine rifleman was 44 kg (or 57% of body weight); the recommended maximum was 30% of body weight.

Exoskeletons and Arms

This listing of 'soldier lethality' modernisation priorities is highly significant, especially the reference to load-bearing exoskeletons. The US military has been interested in the possibilities offered by exoskeletons since the 1960s, the problem was that while the concept might be understood, the technology and materials necessary to make it a valid proposition was not available at that time. Now the situation is very different; the necessary technology and materials are available, and there are a number of exoskeleton and related programmes on the verge of delivering a deployable capability to the US military.

United States Special Operations Command (USSOCOM) is working on a programme known as the Tactical Assault Light Operator Suit (TALOS). Thus far, unpowered versions of this exoskeleton have been tested. The objective is to provide the operator with increased protection as well as enhanced mobility and load-carrying capability. It had been hoped to have a fully functional TALOS system ready this year, but now the plan is to have a fully powered version of TALOS ready in 2019. If all goes well at that point, they will look to upgrade the materials used in the construction of TALOS and that will be the precursor to the system being deployed operationally. TALOS is far more than a technology demonstrator. The objective for USSOCOM is to get a fully operational system deployed into the field as soon as possible.

Lockheed Martin has been working on exoskeleton programmes for some time. Their current offering is the ONYX system which is an exoskeleton focused on the lower part of the body, or, to be more precise the legs. ONYX will enter field testing by the end of this year with the 10th Mountain Division at Fort Drum, New York. The process will see an initial user testing phase, with user ideas then incorporated into an evolution of the system and then a further testing phase, followed by more user input and more testing. By the time this activity is complete in 2020 and, assuming that all has gone well, the ONYX system would be ready for production and subsequent service entry.

ONYX will not make a user cover the ground faster but it will increase endurance and reduce fatigue, enabling soldiers to carry heavy loads of equipment with fewer ill effects. The system will also reduce stress on the legs and this will go a long way to reducing the incidence of orthopaedic injuries. There are still issues to resolve though. One of these is power, and here the requirement is for a lighter weight battery system with more power output. The weight of the ONYX system is another area to be tackled, with new materials being an area of interest.

There are also a number of unpowered exoskeleton programmes being worked on in the US, as well as programmes focussed on powered systems, often also referred to as 'wearable robotics'. The US is not alone in working towards exoskeleton capabilities. Russia has been working on both powered and unpowered systems and Hyundai in the Republic of Korea (ROK) have demonstrated powered exoskeletons for medical and industrial uses, with the same technology obviously providing the basis for a military system.

Photo: Lockheed Martin

The Lockheed Martin ONYX is an exoskeleton focused on the lower part of the body and is due to start trials with the US Army shortly. ONYX will increase endurance and reduce fatigue, enabling soldiers to carry their heavy loads of equipment with reduced injury risk.

Meanwhile, researchers at the US Army Research Laboratory (ARL), part of the US Army Research, Development and Engineering Command, have developed a system known as the THIRD ARM. In response to ongoing requirements to increase soldier lethality, ARL came up with the THIRD ARM device. Although development is still at an early stage, the device is already showing considerable promise. On the surface, it is not a sophisticated device, it is unpowered and has a rather simple design, and it is attached to the waist of the soldier. Made from composite materials, it is a lightweight device (1.8 kg) and its function is to stabilise the weapon that the soldier is using and also remove the weight burden of the weapon on the arms of the soldier. The end result is a system that reduces fatigue due to reduced weight burden and is more accurate as the weapon is stabilised. The system has been tested with the M4 and the M249, as well as with the M240B machine gun that weighs 12.25 kg. Studies on the device continue, with one of the next steps being the integration of other heavier weapons.

Other Approaches

What is immediately apparent is that in the US strenuous efforts are underway to deal with the intertwined issues of reducing the impact of soldier loads, which leads to less fatigue, fewer injuries and an end result of a more effective soldier. The real surprise is why it has taken so long to start looking at solutions to increased soldier loads and the negative consequences of carrying such loads.

When the US Army became engaged in Afghanistan, there was suddenly great concern over the loads soldiers were carrying in combat. This led to a search for more information and it was discovered that the US Army had never performed a study of soldier combat loads; the only data they could find were drawn from a US Marine Corps report based on data from August 1942. This resulted in the Center for Army Lessons Learned (CALL) being commissioned to conduct a study of battlefield loads in "The Modern Warrior's Combat Loads, Dismounted Operations in Afghanistan", with research being conducted in the field in April/May 2003. Unsurprisingly the study established that soldiers were carrying loads that were far too heavy.

In September 2007 the US Marine Corps generated a report by the Naval Research Advisory Committee, under the auspices of the Office of the Assistant Secretary of State of the Navy (Research, Development and Acquisition). The report was entitled "Lightening the Load" and work commenced on the study in February 2007. Sources consulted included the US Marine Corps, US Army, US Department of Defense (DOD), and US Navy Science and Technology (S&T) organisations and industry. Also consulted were foreign militaries from Canada, France, Germany, Singapore and the UK to understand how they were developing Lightening the Load (LTL) initiatives.

The context for the study focused on the three main load categories of a Marine rifleman: the Assault Load, the Approach March Load and the Existence Load. The assault load covers what is needed to conduct combat operations indefinitely with minimal degradation in combat effectiveness. The recommended soldier load is 22.68 kg, or some 30% of soldier weight based on the average 76.77 kg weight of a Marine. The study found that theactual combat load of a Marine rifleman was 44 kg or 57% of body weight. The approach march load is based on conducting a 20-mile (32.18 km) march within eight hours, maintaining 90% combat effectiveness. The recommended load in this context is 34.47 kg or 45% of body weight, in reality the actual load was 55.79 kg or 73% of body weight. The existence load covers limited movement within the confines of transportation platforms and limited marching from landing zone into a secure area. The recommended load is 57.6 kg or 75% of body weight, in reality the load

Photo: US Army ARL

The US Army Research Laboratory (ARL) has developed a system known as the 'THIRD ARM'. The objective of the system is to stabilise the weapon and reduce the weight burden on the arms of the soldier. The M249 shown here being supported by the system has a basic weight of 8.16 kg.

was 75.75 kg or 99% of body weight.
Significantly, the LTL report noted the paucity of information on soldier loads and the impact that these loads had on the effectiveness of a soldier – remember that the first Marines deployed in Afghanistan in 2001 and in Afghanistan in 2003. Which begs the question, why did it take so long to think about these issues? The LTL report also quoted a statement from the Commanding Officer, 1st Battalion, 3rd Marines, on 14 November 2006, who said: "We were ordered to wear everything everywhere in the mountains all the time… Even if you were in great shape, you couldn't keep up with the enemy." Again, one has to wonder who thought that was a good idea.

Photo: Rheinmetall

The Rheinmetall Canada MISSION MASTER Unmanned Ground Vehicle (UGV) already has its first export customer. The system is capable of semi-autonomous or autonomous operation, and the cargo variant can carry a 600 kg payload. Systems of this nature are an effective means of reducing infantry combat loads.

The LTL report also decided to look at the soldier load question in a different manner to the previous US Army effort. They focused on the Marine Rifle Squad, which consists of the squad leader and three four-person fire teams, as well as an attached US Navy hospital corpsman for a total of 14 personnel. The average load of a squad in combat is given as some 735 kg, which is some 408 kg in excess of the recommended soldier load in combat. The LTL report broke down squad load into four categories: 37% was weapons, ammunition and optics, 35% was Personal Protective Equipment (PPE), 26% was food, water, clothing and other, while 2% was accounted by communications equipment. The LCL report noted that the communications load "will increase dramatically in the near and mid-term due to increasing Intelligence, Surveillance, Reconnaissance (ISR) and communications connectivity - and could approach 10% of the squad load."
Finding a solution to the overload problem proved difficult. The LCL report commented that there was no "silver bullet" to weight reduction at the squad level. They stated that:"Load reduction must be addressed in terms of S&T efforts for future weapons and equipment, weight transfer off the squad members and new tactics." The LTL report noted: "Improved/specialised nutrition, physical training, and ergonomics would have a positive, but minimal impact on load carrying capability."
Solutions were possible though. The report believed that planned S&T efforts could make some headway in reducing the overload weight at the squad-level. They believed that 136 kg or 33% of the overload could be saved through "weight reduction developments in advanced personal protection and other equipment." Added to which another 136 kg or 33% of the overload could be saved through "the use of small-unit organic vehicles or other weight transfer techniques." Finding a way to the save the other 136 kg of overload was not addressed.

The Problem Remains

It is now 11 years since the LTL report was published and it would fair to say that there has been progress on LTL initiatives, or, to be more precise the need to reduce combat loads has been understood. Thus far, fielding reduced-weight equipment alternatives for the individual soldier has made limited progress, although any loss of weight helps. The provision of vehicles to carry soldier loads is an obvious avenue for weight reduction; the problem is that conventional vehicles require a driver and impose their own logistic burden. The obvious solution to this dilemma was what the US Army called an "autonomous logistics and equipment vehicle" or more commonly the "robotic mule." A few early systems were tested in Afghanistan, but now the US Army is looking to procure between 2,700 and 5,700 (depending on funding) of these Unmanned Ground Vehicles (UGV) under the Squad Multipurpose Equipment Transport (SMET) programme.
Four contenders have been shortlisted for the SMET programme: the Polaris Industries/ Applied Research Associates /Neva Systems MRZR-X, General Dynamics Land Systems Multi-Utility Tactical Transport (MUTT), HDT Global HUNTER WOLF and the Howe and Howe Technologies RS2-H1. They will be evaluated and a winner selected with the system to be fielded by 2021. According to the US Army the objective of the SMET system is for the UGV to carry some 453 kg of soldier load.
Other UGV alternatives exist. For example, at the Eurosatory exhibition in Paris in June, Rheinmetall Canada displayed their MISSION MASTER UGV. This system is ready for deployment, indeed there is already a first customer for the system, and the variant at Eurosatory was outfitted for the carriage of cargo, although other missions include casualty evacuation/rescue, surveillance, CBRN detection and combat. For example, Germany has reportedly shown interest in a version of the MISSION MASTER mounting the MBDA ENFORCER guided-missile system as a combat UGV. MISSION MASTER can be operated autonomously or semi-autonomously and carry a 600 kg payload.
It is quite possible that the powered full-body exoskeleton will provide the ultimate solution to the requirements of the infantry for load carriage, increased endurance and reduced fatigue. While we wait for exoskeleton technologies to evolve into deployable production systems, it would seem that the optimum LTL strategy is to reduce the soldier load by transferring it to vehicles, depending on requirements, such systems could be UGVs or something as simple as an All Terrain Vehicle (ATV). We have now reached the point where the need for LTL for the infantry is well understood and justifiable, now the challenge is to actually make it happen and field solutions. ■

Wave of the Future?

Hybrid and Electric Drive for Armoured Combat Vehicles

Sidney E. Dean

Electric drive and hydrogen-electric fuel-cell based hybrid drive have become a technically and economically viable power source for civilian passenger and commercial vehicles. Armed forces are increasingly looking to introduce this cutting-edge technology into their own fleets. Diesel-electric hybrid drive is also under serious consideration.

Electric drive: An electric drive system is powered by high-capacity battery packs which are connected to drive units mounted directly in the wheel hubs, eliminating the need for heavy and bulky mechanical drive shafts ("drive-by-wire"). While the battery packs themselves tend to be heavy, the elimination of the mechanical transmission system can balance out the additional burden. Batteries must be charged from an external generator or power grid. Electric drive vehicles currently have a shorter operational range than conventionally powered vehicles.

Hybrid drive: A hybrid drive system consists of an on-board power source which activates on-board electric generators. These generators in turn are linked via cable to electric drive units mounted directly in the wheel hubs, again eliminating the need for a mechanical transmission system. The most frequently considered power sources are diesel engines ("diesel-electric hybrid drive", although any internal combustion engine type is feasible) and hydrogen fuel cells ("hydrogen-electric hybrid drive"). Hybrid systems generally offer an operational range comparable with conventional combustion engine propulsion systems.

Currently the focus is on military utility vehicles which are, for all intents and purposes, rugged counterparts of civilian trucks. However, there is considerable interest in eventually replacing the diesel engines of heavy Armoured Combat Vehicles with electric or hybrid propulsion systems. Electric or hybrid drive would have several advantages over the current hydrocarbon-based propulsion:

Author

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Graphics: US Army

The Next-Generation Combat Vehicle which the US Army hopes to field in the 2030s is expected to have electric or hybrid drive.

- instantaneous high torque for improved acceleration and potentially improved speed;
- improved manoeuvrability for 6x6 and 8x8 vehicles, as the hub-mounted electric motors allow the driver to adjust the rotation speed of individual wheels;
- lower propulsion system weight;
- fewer moving parts to maintain;
- stationary on-board power generation (enabling operation of additional electronic systems including directed energy weapons, active protection systems and electronic warfare suites);
- on-board water generation;
- less danger of explosion or fire if hit by enemy ordnance;
- significantly reduced thermal and acoustic signature, and no visible exhaust (all-electric and hydrogen-based hybrid systems);
- in some instances significantly reduced logistics footprint.

Industry and armed forces of numerous nations are pursuing or investigating next-generation propulsion concepts for armoured combat vehicles. include the following:

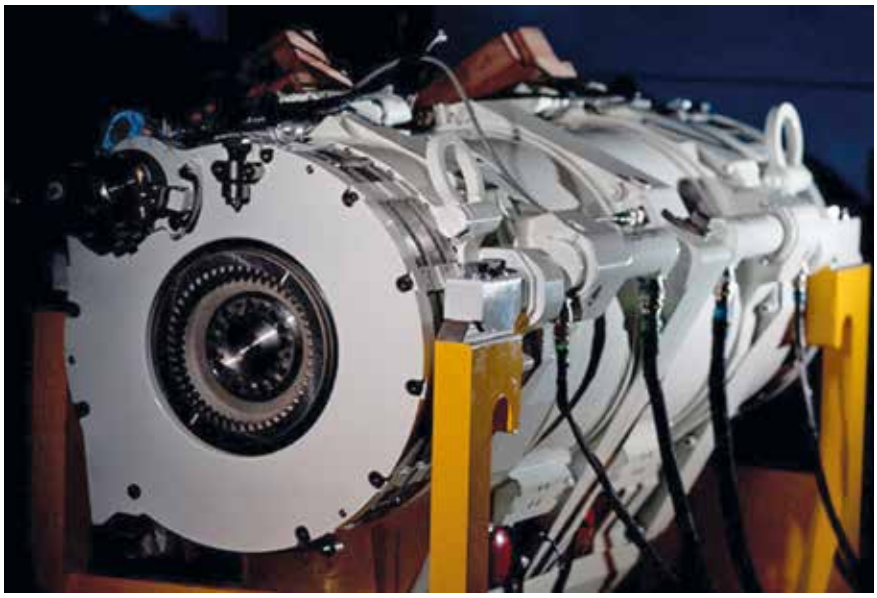
United States

The United States Army experimented with electric drive options for the Abrams Main Battle Tank (MBT) as early as 2010; even earlier (2003-2009) the Army envisioned its abortive Future Combat System vehicles to all be equipped with hybrid diesel-electric propulsion systems. While the concept of electric/hybrid drive appeared promising, the technology at that time proved to be too immature. But that is changing, according to Donald Sando, head of the Capabilities Development and Integration Directorate of the Army Manoeuvre Centre of Excellence (AMCE) at Fort Benning, Georgia.

Speaking at the Association of the US Army (AUSA) annual convention in October 2017, Sando declared that the Next-Generation-Combat Vehicle (NGCV), which is expected to become a family of armoured combat vehicles replacing both the M2 BRADLEY IFV and the M1 Abrams MBT, is likely to run with electric motors and high-capacity batteries capable of being recharged with 10 kW to 50 kW generators. "That's a generational change. And we're going to do it," Sando said. "If

they're not electric or hydroelectric [that is, hydrogen fuel-cell driven] then I'm wrong." During the same presentation he categorically ruled out retrofitting current combat vehicles with an electric propulsion system.
Major General Cedric Wins, commander of the Army Research, Development and Engineering Command (ARDEC), agreed with Mr. Sando's assessment. Also addressing the AUSA convention, Wins spoke in terms of 15-20 years for fielding. In fact, the NGCV is still in the early planning phase. Concept demonstrators have been ordered but will not be delivered until 2022. Over the next six years, various technologies will be explored for their suitability on the NGCV. Proposals include hydrogen fuel-cells and all-electric propulsion systems. "There is a huge amount of investment that would have to occur in research and development" before electric or hybrid powered armoured fighting vehicles could become operational, Wins cautioned.
Both Sando and Wins pointed to private industry's advances in alternative propulsion systems, and they clearly stated that the military intends to capitalise on that expertise. Put another way, the army does not plan to lead the R&D efforts itself, but will rely on and coordinate with industry to determine which civilian developments can be adapted to military requirements. "It's hard to believe that if industry moved in the direction of electric-powered vehicles, that the army would not be somewhere near there," General Wins said at the AUSA convention.

Photo: QinetiQ



The E-X-DRIVE hybrid propulsion system for tracked vehicles

United Kingdom

In the United Kingdom, QinetiQ and BAE Systems have partnered to continue developing and marketing the E-X-DRIVE (a hybrid-electric drive transmission designed for tracked military vehicles up to and including 70+ tonne MBTs) and QinetiQ's HUB-DRIVE Unit (designed for wheeled armoured vehicles). QinetiQ has been pursuing the technology since 1999, and provided it to the US Army for testing in 2012.
The E-X-DRIVE and HUB-DRIVE concepts call for replacing the standard diesel engines of armoured vehicles with on-board diesel generators to produce electricity. The drive shafts, differentials and transmission systems would be replaced by compact electric motors. The design significantly reduces weight while improving torque and vehicle mobility and "potentially" fuel economy. According to QinetiQ, the HUB-DRIVE in its current configuration could be retrofitted on all operational 8x8 armoured vehicles. Be eliminating the need for the current under-vehicle drivetrain, the technology would allow greater flexibility when designing next-generation vehicles. In 2015 and 2016 the Pentagon's Defense Advanced Research Projects Agency (DARPA) awarded QinetiQ contracts to make the firm's hybrid drive available for the agency's Ground-X Vehicles Technologies (GXV-T) programme. The GXV-T programme, in DARPA's own words, "seeks to disrupt the current trends in mechanised warfare" by identifying technologies to radically improve mobility and survivability of armoured fighting vehicles while simultaneously reducing weight and signature.

Sweden and Finland

An early attempt to field tactical vehicles with hybrid drive is Sweden's SEP armoured vehicle series developed by BAE Systems Hägglunds. Testing began in 2000 on a tracked variant, and in 2003 on the 8x8 armoured personnel carrier. The vehicle is outfitted with two Steyr diesel engines which are connected to ZF electrical generators. The generators are connected by cable to the electric motors embedded in each wheel hub. When the SEP is not in motion, the generators charge the vehicle's batteries. When switching to battery power, the SEP can run in silent mode. Another advantage of the system is reduced diesel fuel consumption, as the SEP runs part of the time on electric drive. However, the SEP was cancelled in 2008. Notably, the Ministry of Defence explained the decision with the high cost of developing the SEP

Photo: US Army

All manned vehicles of the proposed Future Combat System were to be equipped with hybrid drive. The programme was terminated in 2009 over cost issues and technical difficulties, not specifically related to the drive concepts.

without at least one foreign partner; had Britain joined the programme as originally expected, Stockholm would have procured the hybrid-drive vehicle. The Swedish Army ended up buying the Finnish-built BAE Patria AFV and the Patria Combat Vehicle 90, both with conventional diesel engine propulsion.

Israel

Outside Europe and North America, Israel is a leader in hybrid propulsion research and development. The Israeli Defence Force (IDF) is currently pursuing Project Carmel, a technology demonstrator for a next-generation light tank to be fielded in the late 2020s. According to IDF Brigadier General (retired) Didi Ben-Yoash, who now runs Project Carmel, hybrid drive is considered essential for the new tank. Details of the system are still under development. At this point observers speculate that the hybrid drive will be of the diesel-electric variety rather than hydrogen-electric.

Epsilor Electric-Fuel, an Israeli subsidiary of US-based Aerotech, is currently developing enhanced battery solutions for the Merkava IV MBT deployed today. These new lithium-ion batteries have three times the energy-density of currently employed lead-acid batteries, yet retain the standard T6 form employed in heavy armoured vehicles. These new batteries are primarily designed to enable extended silent watch operations (during which the tank shuts off its engine but continues to run sensors and other electrically powered equipment) by today's generation of heavy tank. However, Epsilor and numerous other companies are constantly pursuing greater efficiencies. Lithium-ion batteries' cost per kilowatt-hour has dropped by sixty percent over the past five years, said Epsilor's vice-president for marketing, Felix Frisch; during the same timeframe the energy density of lithium-ion batteries has improved by 35 percent. If this trend continues at the same pace, battery technology will be well positioned to support hybrid-drive armoured combat vehicles in the next decade. "Militaries that embrace this revolution early on will be the first to benefit from the way electric power can be used to change the way armoured vehicles are used and supported in the field," Frisch said during a manoeuvre warfare conference in May 2017.

China

China is developing an as yet unidentified (in the West) state-of-the-art Infantry Fighting Vehicle which is thought to have a hybrid propulsion system. Presumably being developed by NORINCO, The new IFV – presumably being developed by NORINCO – might be the unidentified new armoured vehicle whose photo was posted on the CJDBY website in February 2017. The Chinese Army has been experimenting with non-conventional drive for some time, including testing of an MBT prototype dubbed the T-95E circa 2010. Based largely on the abortive Russian T-95, the T-95E featured a hybrid diesel-electric drive; lessons from that testing programme will have supported the current IFV development.

Photo: BAE Systems

BAE Systems has partnered with QinetiQ to market hybrid propulsion systems for armoured fighting vehicles. BAE Hägglund's SEP armoured vehicle, shown here in the tracked configuration, was developed in 2004 with an optional diesel-electric hybrid drive.

Logistics impact

Despite the promised performance enhancement of electric and hybrid systems, it is the logistics aspect which is receiving the most attention. Advocates of new propulsion systems stress the benefits of eliminating the reliance on hydrocarbon fuels such as diesel and J-8. Main Battle Tanks (MBTs) and Infantry Fighting Vehicles (IFVs) are the most fuel-intensive ground vehicles. For example, a single M1 ABRAMS MBT requires nearly two gallons per mile travelled. A company of 14 M2 BRADLEY IFVs consumes 2,300 gallons of fuel daily during operations in rugged terrain, according to a US Army logistics forecasting model published in 2016. Over the past two decades heavy brigades have repeatedly stalled in combat zones because they had outrun their supply vehicles and had to wait for fuel. The other side of this coin: a significant percentage of coalition casualties in Afghanistan and Iraq were suffered by supply convoys. Reducing or eliminating the reliance on diesel fuel would enhance operational flexibility and reduce risk.

On the other hand, switching to a hydrogen-based hybrid propulsion system could conceivably even complicate battlefield logistics, at least in some theatres. Diesel can be procured from local suppliers almost anywhere; liquid hydrogen for hybrid-driven tanks would, by contrast, have to be shipped into some regions. As an alternative the military could set up in-theatre facilities to extract hydrogen from military grade fuel, but this would be a new logistical burden, and would still require convoys to supply the operational vehicles in the field. Likewise, purely electric vehicles would require access to an established power grid, or would require mobile generators (and the fuel to operate them) to accompany combat units. Establishing a power grid in underdeveloped and hostile terrain could end up dwarfing the logistical and engineering challenge of establishing fuel depots and convoys.

Perhaps this is why acceptance of non-traditional drive concepts for heavy armoured vehicles has remained slow. STK's TERREX Armoured Fighting Vehicle, in production since 2006, was originally designed with an optional hybrid drive system; neither Singapore nor Indonesia nor Turkey were interested, opting instead for conventional diesel propulsion. More recently, in 2015, Turkey's Otokar proposed an electric drive for Ankara's new Altay MBT. The Turkish Army preferred to stay with a tried-and-true conventional drive system, which Otokar is now offering in its 2017 bid for the Altay development project. And in 2013 BAE's platform manager for the CV90 stated that his firm was considering upgrading that vehicle to a hybrid drive, both in order to reduce fuel consumption and to enhance performance; however, no decisions have been announced to date. Until laboratories demonstrate battery packs and hybrid systems with greater efficiencies, most Western armed forces will be wary of experimenting with promising but unproven battlefield technology. It seems that China, and perhaps Israel, appear more willing to accept the risks in order to reap the tactical advantages the new technology purports to offer. ■

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Blue Water Naval Ships

Conrad Waters

The opening years of the 21st century have seen many countries striving to join the handful of nations with 'blue water' navies capable of projecting power across the deep waters of the world's oceans.

Precise definitions of a true blue water capability differ. However, most agree that possession of sophisticated surface combatants that can deploy at distance to engage in high-intensity warfighting is a prerequisite of such a capacity. In spite of the significant expansion in naval shipbuilding across the globe in recent years, there are still only a few countries that possess the range of competencies needed to design and build such capable ships. This article reviews the main programmes that are currently underway.

United States

The US Navy remains the world's undisputed blue water naval power. It is also remarkable in that the design of its principal ocean-going surface combatants – the ARLEIGH BURKE (DDG-51) class destroyers – dates back nearly 40 years to the closing stages of the Cold War. The first ship of the class was commissioned in 1991, and production was originally expected to end in FY2005, when 62 units had been ordered. However, dissatisfaction with the cost and narrower capability focus of the follow-on ZUMWALT (DDG-1000) design resulted in a resumption of orders from FY2010 onwards. A further 17 had been procured through to FY2018. Current plans envisage ongoing production of BURKE class ships throughout the US Department of Defense's five-year Future Years Defense Program (FYDP) for FY2019-FY2023. Moreover, a definitive roadmap towards a replacement design has yet to be announced.

The BURKE design is a large, gas turbine-powered multi-mission surface combatant with a focus on anti-air warfare. Production is split between General Dynamics' Bath Iron Works in Maine and Huntington Ingalls Industries' Ingalls Shipbuilding in Pascagoula, Mississippi. The class owes its remarkable longevity to the flexibility of the core technologies incorporated into its original specification. The most significant of these are the integrated AEGIS system providing command and weapons control functions and the Mk 41 vertical launch system (VLS) housing much of the design's armament. AEGIS has proved capable of ongoing evolution to accommodate enhanced functionality and a broader spectrum of roles, notably in the area of ballistic missile defence (BMD). Equally, the Mk 41 system's ability to accommodate a wide range of munitions has allowed the balance of weaponry to be shifted in line with changing requirements. These have included TOMAHAWK cruise missiles – the weapon of choice in post-Cold War interventions – and the Standard SM-3 used for ballistic missile interception.

The evolution of AEGIS and the expanding range of missiles deployed have been accompanied by the development of the BURKE class platform through a series of iterations or 'flights'. Some changes have been relatively minor and some more significant. In particular, the Flight IIA variant, introduced from FY1994, was lengthened by 5 ft to incorporate a two-helicopter hangar and also received improved internal blast protection. At the moment, production is transitioning to the new Flight III design. Assembly of the first of this series – JACK H. LUCAS (DDG-125) – commenced at Pascagoula in May 2018. The new flight introduces Raytheon's new scalable AN/SPY-6 Advanced Missile Defence Radar (AMDR), which replaces the AN/SPY-1 arrays previously associated with AEGIS. This change is accompanied by power generation and structural upgrades needed to support the new radar.

Although undoubtedly a successful series of ships, there is a growing recognition that the BURKE class is now reaching the limits of further development. The design's power generation and distribution architecture is ill-suited for the coming generation of directed-energy weapons and there is little margin left to accommodate further equipment in the existing hull. It also lacks many of the stealth features found in more recent warship designs, whilst a heavy crewing requirement makes for relatively high operating

Photo: US Navy

The US Navy's AEGIS-equipped ARLEIGH BURKE (DDG-51) class destroyers have evolved through a series of "flights". This image shows the enlarged Flight IIA variant FORREST SHERMAN (DDG-98) in the foreground and the Flight IA LABOON (DDG-58) refuelling from the oiler JOHN LENTHALL (T-AO-189) in January 2013.

Author

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Blue Water Warship Programmes – Specimen Designs							
Country	Crew	Type/Year	Class	Displacement	Dimensions	CMS	Propulsion
United States	320	Destroyer (DDG) 2000	DDG-51 (Flight IIA)	9,400 tonnes	155m x 20m x 7m	AEGIS	COGAG
China	280	Destroyer (DDG) 2014	Type 052D	7,500 tonnes	156m x 17m x 6m	Indigenous	CODOG
China	190	Frigate (FFG) 2008	Type 054A	4,000 tonnes	132m x 15m x 5m	Indigenous	CODAD
Japan	300	Destroyer (DDG) 2007	ATAGO	10,000 tonnes	165m x 20m x 6m	AEGIS	COGAG
Japan	230	Destroyer (DD) 2018	ASAHI	6,800 tonnes	151m x 18m x 5m	OYQ series	COGLAG
South Korea	300	Destroyer (DDG) 2008	KDX-III	10,500 tonnes	166m x 21m x 6m	AEGIS	COGAG
India	330	Destroyer (DDG) 2014	Project 15A	7,400 tonnes	163m x 17m x 7m	BEL CMS	COGAG
India	265	Frigate (FFG) 2010	Project 17	6,200 tonnes	143m x 17m x 5m	BEL CMS	CODOG
Russia	210	Frigate (FFG) [2018]	Project 22350	5,500 tonnes	135m x 16m x 5m	Indigenous	CODAG
France	110+	Frigate (FFG) 2012	FREMM	6,000 tonnes	142m x 20m x 5m	SETIS	CODLOG
Italy	145	Frigate (FFG) 2013	FREMM	6,700 tonnes	144m x 20m x 5m	ATHENA	CODLAG
Spain	200	Frigate (FFG) 2002	F-100	6,300 tonnes	147m x 19m x 5m	AEGIS	CODOG
United Kingdom	155	Frigate (FFG) [2025]	Type 26 (GCS)	7,000 tonnes	150m x 21m x 5m	CMS-1	CODLOG

Note: 1. Figures are approximations and often subject to a degree of speculation. They can also change dependent on variant. They are provided only to give a general indication of overall size and capacity.

costs. Current thinking on a planned future large surface combatant appears to envisage combining the AMDR-based combat system upgrade introduced in the Flight III ships with a new hull and electrical arrangement. The integrated electrical power (IEP) system used in the three ZUMWALT class destroyers that survived the programme's demise may prove influential in this regard.

The US Navy's decision to retire its traditional frigate force in favour of the littoral combat ship type means that there are currently no second-tier surface combatants in service to supplement its destroyers in the oceanic role. This situation will change once the FFG(X) programme for a new multi-mission frigate starts to deliver ships during the 2020s.

China

China's rapidly expanding People's Liberation Army Navy (PLAN) is widely regarded as the US Navy's future blue water rival. It has grown its force of oceanic surface combatants significantly during the past decade and further quantitative and qualitative developments are in the pipeline. The PLAN's

Photo: Royal Australian Navy

The Type 052 destroyer series currently forms the high-end of China's ocean-going warship force. This is the Type 052C class destroyer HAIKOU in April 2016.

Photo: US Navy

Japan and South Korea have adapted the basic US Navy DDG-51 ARLEIGH BURKE class design for their own requirements. This is the Republic of Korea Navy's SEJONG THE GREAT in June 2016 – she is considerably larger than any of the US Navy AEGIS-equipped destroyers.

development of these ships has followed a somewhat different trajectory than that adopted by the US Navy. Notably, it has constructed two distinct series of high-end destroyers and second-tier frigates for oceanic deployment. Its destroyers, particularly, have also seen a somewhat swifter process of design development than their US Navy counterparts, albeit a similar evolutionary approach is still evident.

The high-end of China's blue water surface fleet is dominated by the Type 052 series of destroyers. This originated in two pairs of Type 052B and Type 052C ships delivered, respectively, in 2004 and 2005. The Type 052B utilised much Russian-derived equipment, but the Type 052C introduced a Chinese phased array radar and VLS to the same basic hull. Both variants incorporated a combined diesel or gas (CODOG) propulsion system and a significant amount of stealth technology. A further quartet of Type 052C class destroyers was delivered early in the current decade. However, construction has now switched to the improved Type 052D design. These continue to utilise the same hull as the earlier ships but benefit from further radar, VLS and other armament enhancements. They are being assembled by both the Jiangnan yard in Shanghai and by Dalian Shipbuilding Industry Company. Eight were in service as of mid-2018 and an eventual total of around 20 seems likely.

Attention is now turning to the new Type 055 destroyer project. This has seen four ships launched by July 2018. Although owing much to the previous Type 052 designs, these are larger ships displacing over 10,000 tonnes that are much closer conceptually to the US Navy's destroyers. Reports suggest equipment includes around 112 VLS cells, nearly double the number found on China's previous ships. There is also an innovative dual-band radar arrangement similar to one originally specified for ZUMWALT but later cancelled on cost grounds. The Type 055 class are seen as complementing the other destroyer classes and will likely be used as key components of the carrier strike groups the PLAN is intending to establish.

The large destroyers are supplemented by the Type 054 series of frigates that have entered service in considerable numbers. Two prototype Type 054 class ships were commissioned in 2005. However, production swiftly switched to the improved Type 054A variant that have been delivered from 2008 onwards. These share a common c. 4,000-tonne hull and diesel propulsion system with the earlier pair but incorporate an area air defence capability derived from Russian technology. Assembly is shared between the Hudong-Zhonghua yard in Shanghai and Guangzhou's Huangpu Shipbuilding Company. Thirty of the type have been launched to date and they form the blue water 'workhorses' of the PLAN's globally deployed task groups. Production now appears to be drawing to a close as a new Type 054B or Type 057 frigate is reportedly in the final stages of development. This will benefit from technological advances in the 20 years since the Type 054 series was conceived, most likely including some form of electrical propulsion.

Japan and South Korea

The Japan Maritime Self-Defence Force (JMSDF) and Republic of Korea Navy have both benefitted from strong domestic shipbuilding and electronics industries as well as long associations with the US Navy in developing their own blue water surface combatants. This is reflected in considerable design similarities amongst their respective high-end oceanic warships. However, the two navies' different historical backgrounds and operational commitments mean that there are also significant variations between their respective blue water fleet structures.

Photo: JMSDF

Japan's JMSDF has developed a series of steadily evolving destroyer designs for trade route protection. This is the lead AKIZUKI class ship on trials – she was commissioned in 2012.

The major common element of JMSDF and Republic of Korea Navy procurement has been the development of warships derived from the US Navy's BURKE class as their most powerful surface units. The JMSDF took an early lead, commissioning four KONGOU class destroyers between 1993 and 1998. These were followed by two larger ATAGO class ships delivered in 2007 and 2008. A further pair of upgraded ships – the '27DDG' type – have been ordered. Construction has been split between Mitsubishi Heavy Industries and Japan Marine United. Meanwhile, South Korea commissioned three SEJONG THE GREAT (KDX-III) class destroyers built by Hyundai Heavy Industries and DSME between 2008 and 2012 and is committed to acquiring a further three. All incorporate the AEGIS system and SPY-1 arrays used in the original BURKE class design. Consequently, they benefit from the same flexibility and inherent potential for upgrades associated with their American cousins. For example, all the Japanese ships have been or will be modified for the BMD role, and it is planned to introduce the same capability in the new South Korean destroyers. However, both countries' series of vessels incorporate numerous national variations from their American counterparts, including provision for domestically-produced weapons and other equipment. The 10,500-tonne KDX-III class vessels, in particular, are significantly larger than any of the BURKE class flights to accommodate additional VLS cells.

South Korea's inevitable focus on deterring its aggressive northern neighbour means that its warship procurement has, of necessity, been balanced between littoral and oceanic elements. The navy's other current surface warship programme – involving incrementally improved batches of FFX type frigates – therefore has a strong focus on coastal and near seas operations.

By contrast, the JMSDF has traditionally prioritised protecting the country's maritime trade routes at some distance from the home islands. It has emphasised sophisticated anti-submarine escorts to supplement the broader range of capabilities provided by allied US Navy forces. This has resulted in a series of destroyer designs that trace their origins to the HATSUYUKI (DD-122) class, which was first authorised in 1977. Each succeeding class has been typified by an evolutionary approach to overall design accompanied by incorporation of the latest weapons and electronic systems. The most recent iteration is the current ASAHI (DD-119) class, which saw its lead ship commissioned in March 2018. A key design feature is an innovative combined gas and electric and gas (COGLAG) propulsion system. The new ships were also intended to be cheaper than earlier classes but savings have been modest. Accordingly, future construction will shift to a smaller '30DD' medium surface combatant displacing around 4,000 tonnes. These will seemingly place a greater emphasis on littoral operations and have much in common with South Korea's FFX.

Photo: US Navy

The Project 015A class destroyers are the Indian Navy's most modern blue water surface combatants. Here the lead ship KOLKATA is seen in company with the Royal Navy's Type 45 destroyer DEFENDER in 2016.

India

The Indian Navy is, perhaps, the most established of the Asian blue water navies. Its approach to blue water warships shares similarities with China's PLAN, most signifi-

cantly with respect to the development of separate series of oceanic destroyer and frigate designs. It has also emphasised indigenisation of warship construction and equipment, albeit with less success than its Chinese rival.

Indian destroyer construction is focused on the Project 15 series. These have all been built by Mazagon Dock at Mumbai. Deliveries commenced with the first 6,700-tonne Project 15 vessel, DELHI, in 1997 after a lengthy 10-year construction period. She was followed by two further vessels in 1999 and 2001. In common with other recent Indian warships, equipment mix is eclectic. It includes Ukrainian gas turbines; European, Israeli and Russian weapons and sensors; and an indigenously developed combat management system. Production subsequently switched to the upgraded Project 15A KOLKATA class. These ships use the same hull and propulsion system as the preceding class but incorporate more stealth technology and a different mix of armament and sensors. Notably, the specification of an IAI Elta MF-STAR multifunction radar and BARAK 8 surface-to-air missiles provides an up-to-date air defence capability. Three ships were delivered between 2014 and 2016 after build times that were just as long as those for the earlier vessels. Work is now underway on all four

Photo: Naval Group

The lead French anti-submarine FREMM variant AQUITAINE, here pictured on trials in April 2011.

ships of the Project 15B VISAKHAPATNAM class, a further, more modest evolution of the preceding design. Like all the earlier ships, construction has been badly delayed. The frigate counterparts of the Project 15 series of destroyers are the Project 17 series of frigates. Three initial 6,200-tonne Project 17 SHIVALIK class ships were also built at Mazagon Dock, from where they were delivered between 2010 and 2012. They were the first Indian surface combatants to incorporate significant – if still limited – amounts of stealth technology but are otherwise similar to the larger DELHI class in their disparate sourcing of key equipment. Construction has now progressed to the

Photo: Fincantieri

The Italian FREMM variants share a similar hull and overall design with their French counterparts but incorporate significant differences in equipment. Here, the first Italian anti-submarine variant VIRGINIO FASAN (foreground) is seen with the general purpose CARLO BERGAMINI in June 2012.

Project 17A class, which appears to be a more marked leap forward compared with the relatively steady process of evolution seen with the Project 15 series. Seven ships will be shared between Mazagon Dock and Kolkata's GRSE, and it is hoped that deliveries will commence in 2023. However, India's consistent failure to define a more uniform group of suppliers from which to develop its own naval equipment and the poor performance of its shipyards suggest it will continue to lag China in developing its blue water warships.

Russia

The former Soviet Union designed and built many potent oceanic surface combatants during the Cold War. However, much of this capability became fragmented following the Union's dissolution. This – and the funding crisis that followed the Cold War's end – meant that many relevant skills were lost. Russia has subsequently invested large sums in rebuilding its naval capabilities. However, in spite of much rhetoric, construction of new blue water surface combatants has been accorded a comparatively low priority. This stance has been confirmed in the recent State Armaments Programme for 2018-2027 (GPV2027), which places greater emphasis on submarines and 'green water' surface warships.

With construction of further Project 11356 ADMIRAL GRIGOROVICH class frigates effectively suspended for want of Ukrainian turbines, the sole active programme for major warships is for the Project 22350 ADMIRAL GORSHKOV class. The design of these ships dates to the turn of the millenium. However, the lead ship was not laid down by Severnaya Verf in Saint Petersburg until 2006. She was still completing trials as of mid-2018, nearly four years after her maiden voyage. A further three ships of the class are under construction.

Displacing around 5,500 tonnes, the Project 22350M design is a multirole oceanic combatant with a wide range of anti-air, anti-surface and anti-submarine weaponry. A focal point of the new ships is the Poliment-Redut area air defence system. This combines a Poliment active phased array with a Redut VLS housing a range of surface-to-air missiles. A variant of the system has also been installed in the smaller Project 20380 littoral corvettes but it has reportedly suffered from teething troubles during trials on GORSHKOV. This could account for the extended trials period.

Current plans envisage transitioning frigate construction to a larger Project 22350M variant when either four or six of the current class have been completed.

Continental Europe

Whilst most European navies suffered a marked decline in resourcing after the Cold War's end, the leading fleets have remained in the forefront of major warship design and construction. Indeed, a greater emphasis on expeditionary operations has meant that investment in blue water warships able to operate at distance from their home bases has often been accorded priority over other requirements.

The largest European construction programme for oceanic combatants remains the Franco-Italian FREMM project for multi-mission frigates. The programme resulted from a requirement that emerged during the 1990s for both countries to renew the bulk of their front-line surface escort forces in the face of block obsolescence of existing vessels. Their two navies had previously collaborated on the HORIZON project for air defence frigates and there were strong political and industrial reasons for continuing this cooperation. As such, it was agreed to adopt a common hull form and broadly similar propulsion architecture for the multi-mission ships. At the same time, different operational requirements were reflected in acceptance of considerable differences with respect to superstructure, weaponry, platform management and electronic systems.

The end result has been the production to date of a total of twenty ships of fundamentally similar basic design but with significant differences in appearance, equipment and role orientation. Of these, ten are Italian variant FREMMs in anti-submarine and general purpose configurations; eight are French variant FREMMs optimised for anti-submarine operations and two are French types focused on the air defence role. Common themes include an emphasis on stealth originating from the older French LA FAYETTE class and a focus on reducing complement through automation. The Marine Nationale originally hoped to crew its ships with as few as 108 personnel – India's Project 17 frigates have 260 – although this has proved overly optimistic in practice. The ships have been constructed by Fincantieri at Riva Trigoso and Muggiano and by Naval Group at Lorient.

The FREMM has attracted significant export interest, with French variants sold to Egypt and Morocco. The Italian type was shortlisted but rejected for Australia's frigate programme and is one of the designs being considered for the US Navy's FFG(X). However, there is a school of thought that the type is overly complex for the needs of many navies. Accordingly, the follow-on French FTI (also known as BELH@RRA) and Italian PPA projects are for cheaper ships. Interestingly, these programmes have been pursued on national lines, an approach that may be revisited given the growing alliance between Naval Group and Fincantieri's warship business.

Spain is another European country with high-end warship design and construction capabilities, commissioning five c. 6,300-tonne F-100 type frigates of the ÁLVARO DE BAZÁN class from 2002 onwards. The class was significant in introducing AEGIS and SPY-1 arrays into a frigate-sized hull. Like the larger US Navy BURKE class that also uses this equipment, the ships are multi-mission warships with an air defence emphasis. The Spanish Navy ships were all built by Navantia at Ferrol but three have also been built under licence for the Royal Australian Navy in Adelaide. Navantia subsequently unsuccessfully offered a variant of the design for Australia's future frigate requirement but the type is currently being considered for the FFG(X) and Canadian Surface Combatant competitions. Meanwhile, Spain is in the final stages of developing a new F110 design that will have a greater orientation towards anti-submarine warfare than the air defence-focused F-100. These will be an evolution of the existing class with a distinctive integrated mast and a flexible multi-mission bay.

Germany has also long been involved in the construction of sophisticated surface combatants – largely based on the successful modular MEKO technology – for both the Deutsche Marine and for export. The latest iteration is the F125 class of BADEN-WÜRTTEMBERG stabilisation frigates, which combine the oceanic endurance of blue water vessels with a focus on lower-intensity interventions. The follow-on MKS-180 type will be a more traditional warship capable of high-intensity warfighting. However, the recent exclusion of Germany's thyssenkrupp Marine Systems from the design competition for these ships means that the continuation of the MEKO line is an open question.

United Kingdom

Possibly second only to the United States in its ability to design high-end oceanic warships, Britain's Royal Navy launched construction of its next generation Type 26 frigates – also known as the Global Combat Ship (GCS) – in July 2017. The c. 7,000-tonne design is intended to be a multi-mission warship capable of operating in intensive warfare scenarios. It has sufficient flexibility to incorporate a wide range of equipment fits but the Royal Navy's main intended use for the new frigates is for anti-submarine warfare. This is reflected in selection of a combined diesel-electric or gas (CODLOG) propulsion system and a strong emphasis on acoustic stealth. Other design elements include an adaptable mission bay capable of housing a wide range of equipment and an emphasis on the use of automation to reduce crewing requirements that is shared with other recent European designs.

Three Type 26 GLASGOW or CITY class frigates have been ordered from BAE Systems' Clyde yards to date. A further five are planned. The GCS has also recently been selected as the basis for Australia's nine new HUNTER class frigates, which will be assembled locally in Adelaide. Another variant is a leading contender for Canada's 15 proposed Canadian Surface Combatants.

The Royal Navy is also in the middle of a procurement competition to acquire a new class of Type 31e frigates. Like France's FTI and the Italian PPA these are focused towards securing export sales. Whilst intended to be deployed at distance, they are unlikely to have the full spectrum of warfighting capabilities required of a true oceanic combatant.

Photo: Navantia

The Spanish F-100 class design has been notable in seeing the AEGIS combat system and associated SPY-1 radars in a frigate-sized hull.

Conclusion

This brief review of blue water warship programmes reveals a few key themes. Most significantly, oceanic surface combatant programmes can be seen to have followed a broadly evolutionary path since the millennium. Design improvement has frequently been based on the modification of existing hulls or, at least, followed a natural progression from previous classes. However, there are signs this process may be reaching its practical limits. Interestingly, most innovation has been achieved by the European navies. This is evident in areas ranging from stealth through to propulsion technology and automation. One explanation for this is the imperative of reducing operating costs – particularly crewing – in an era of stretched budgets. Another is possibly the opportunity provided to revisit design characteristics as fleets have switched from a regional defensive focus to a broader range of global missions.

Looking to the future, oceanic warship design will continue to change. The likely debut ofdirected-energy weapons has considerable implications for platform architecture, particularly with respect to power generation and distribution. Equally, growing use of robotic vehicles offers the prospect of distribution of sensors and weapons away from a host vessel. When combined with advances in the areas of combat systems and communications – particularly cooperative engagement capability – blue water operations could see a significant acceleration in tempo. The cost of such developments will not be cheap. Possession of blue water warships is likely to remain an exclusive club. ■

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Land Attack from the Sea

Luca Peruzzi

Sea-launched cruise missiles (SLCMs) have played an irreplaceable role in almost every major crisis since the Gulf War.

Photo: US Navy

TOMAHAWK launch from a US Navy destroyer

Their long range, low signature and accuracy coupled with available man-in-the-loop capabilities to cope with dynamic situations allow the conduct of surgical operations far ashore in defended or contested environments. Littoral scenarios warfare, however, characterised by at sea and ashore targets in cluttered and dynamic environments, have pushed weapon systems manufacturers and operators to introduce not only enhancements to anti-ship missiles to cope with these demanding scenarios, but also land attack capabilities to enlarge the operational toolbox at the commander's disposal. These weapons' export market is, however, subjected to the Missile Technology Control Regime (MTCR) treaty, limiting range and payload respectively to 300 km and 500 kg.

Sea-Launched Cruise Missiles

The combat-proven TOMAHAWK SLCM will continue to be at the heart of the US Navy's and UK Royal Navy's land attack strike capabilities from sea, through a planned mid-life recertification programme as well as other enhancements. These include the ability to operate with greater impunity in jamming or anti-access/area denial (A2/AD) environments and the introduction of a new multi-mode seeker for anti-surface operations. With over 2,500 missiles launched in combat and test operations, the Raytheon SLCM is in service with US Navy's ships and submarine mostly in the family's latest Block 4 or Tactical Land Attack TOMAHAWK (TLAM) version (Block 3 being retired within 2018), as well as the UK Royal Navy's submarines. The US Navy is to sustain the Block 4 rounds inventory until the mid to late 2040s, through its anticipated service life (30 years) via a mid-life recertification programme, starting with missiles reworking from first quarter of FY 2019. In parallel to this programme also involving UK inventory, the missile will receive upgrades to the navigation and communication suite including a new advanced communication architecture based on an integrated single box solution (ISBS) radio and two new satellite antennas (covering the current UHF band and a second frequency band) replacing current systems to address both hardware obsolescence and communication infrastructure phasing-out. A new M-code capable GPS receiver will also be introduced from FY 2022 to work with the next-generation US military GPS satellite constellation. The cooperatively funded US/UK Joint Multi-Effects Warhead System (JMEWS) and fuse enhancements soon-to-be programme of record will enable emerging neutralisation requirements to be dealt with, including hard and deeply buried targets (HDBTs). Under the Maritime Strike TOMAHAWK rapid de-

Photo: Luca Peruzzi

The BrahMos supersonic cruise missile has been developed to be deployed by vertical and inclined launchers from submarines and ships.

Photo: Luca Peruzzi

The multipurpose 3S-14 launcher of the 3R-14 UKSK ship general-purpose firing system

Photo: MBDA

The MBDA MdCN firing from a Naval Group A70 VLS

ployment capability programme, Raytheon also received a contract in September 2017, to integrate a new multi-mode seeker to engage moving maritime targets into a yet-to-be-determined number of Block IV munitions, with deliveries starting from FY 2022. Main software and hardware enhancements are also being introduced into the weapon control system ashore and on naval platforms. Additionally, in January 2017 the US Navy and Raytheon demonstrated the on-board capability (normally carried ashore) to plan, load, launch and provide post-launch control of the TOMAHAWK weapon missions with two at-sea missile firings, to deal with dynamic or urgent operations, without ashore support. Raytheon, however, maintains foreign military sales production capabilities beyond the United Kingdom.

The Russian Federation Navy's first use in anger of Novator JSC KALIBR (CLUB for the export market) SLCM in October 2015 and the subsequent operations through the Syrian crisis, together with the development of a smaller ship fleet but with greater strike capabilities, made a significant impact on the world naval strategic balance. Developed as a member of the KALIBR family of surface- and submarine-launched antiship, land-attack and antisubmarine weapon systems, the 3M-14 land-attack cruise missile (US designation SS-N-30A) comes in the surface-launched 3M-14T and submarine-launched 3M-14 versions, which differ for 3M-14T using the transport launch container (TLC) that is loaded in and fired from either vertical or inclined launchers. With an 8.9-metre length with TLC (6.2 metres without) and a 3,150 kg (vs 1,696 kg) weight, the 3M-14 is equipped with folding wings, a booster and a low-altitude subsonic sustainer, range of 1,500–2,000 km (limited to 275 km for export) according to the Russian MoD. For guidance and targeting, the missile uses pre-programmed data, Doppler/inertial navigation, a GPS/GLONASS satellite navigation receiver, a radar altimeter, terrain profiling, and the ARGS-14 radar seeker for terminal guidance, delivering a 450 kg unitary warhead. A new version of the widespread 3R-14 UKSK ship general-purpose firing system (SGPS) including 3S-14 launchers is under development in order to fire not only KALIBR and YAKHONT/BrahMos missiles but also other types of in-service and future weapon systems, including the 3M22 ZIRCON. The KALIBR ASCM/SLCM family is in service with China, India, Algeria and Vietnam and is promoted on the export market in new versions, including the concealed standard shipping container (CLUB-K) stored/launched variant.

The year 2017 marked a significant period in the development of land-attack capabilities from sea programmes across major navies around the world. Since the beginning of last year, the French Navy has had the Missile de Croisière Naval (MdCN) otherwise known as the MBDA Naval Cruise Missile (NCM) by the Marine Nationale, embedded on the AQUITAINE class multi-mission frigates (FREMM). Launched in December 2006 with the French Procurement Defence Agency contract notification to MBDA group, the MdCN development and production programme registered a test and qualification firing trials campaign which started in 2010 and culminated in October 2014, followed by the successful firing indicated as the first by a European-made cruise missile from a European combatant ship, represented by the French Navy's Aquitaine frigate, in May 2015. Based on the same functional, targeting and mission planning architecture of the SCALP-EG/STORM SHADOW air-launched conventionally armed stand-off cruise missile, but with a low radar cross-section and cylinder-shaped airframe with folding-out fins and wings to be launched from 533 mm torpedo tubes, the 5.5-metre long and 1,400 kg heavy high-subsonic MdCN is equipped with a 250 kg unitary warhead and a Microturbo TR50 turbojet, providing a range of about 1,000 km according to latest released figures. The MdCN shares the following attributes with the SCALP-EG/STORM SHADOW the guidance system, which combines INS, GPS and terrain profile matching with an imaging infrared (IR) seeker with automatic target recognition (ATR) capabilities, to achieve metric accuracies in the terminal phase. Capable to be VLS- and tube-launched, respectively, from ships and submarines, the first MdCN deliveries were accomplished in February 2017, to be followed by a second batch in 2018. The 150-missile (initially 200 but later reduced) procurement includes 100 rounds for the FREMM deployment and 50 for the BARRACUDA(SUFFREN) class nuclear attack submarines, which first-of class will be delivered in 2020. The first MdCN deliveries for the latter purpose are planned for 2019. The MdCN is being promoted on the export market and is reported to have been offered to Poland and Qatar.

The Indian Navy joined the restricted club of naval forces deploying land-strike weapon systems in April last year, with the maiden firing of BrahMos land-attack supersonic cruise missile version from a TALWAR class frigate against a land-based target. Developed by BrahMos Aerospace, a joint-venture between the Russian Federation's NPO Mashinostroeyenia and In-

Photo: SAAB

The newest generation version of RBS 15 will be deployed from GRIPEN aircraft and VISBY corvettes.

Photo: Kongsberg

NSM in Flight

dia's Defence Research and Development Organisation (DRDO), as a multi-platform-launched missile derived from the Russian P800 YAKHONT (3M55 ONIKS) weapon system, the BrahMos is a 3,000 kg heavy and 8.9-metre long two-stage powered missile with supersonic speed of 2.8 Mach and a range of 290 km, which is being progressively increased, after India joining the MTCR treaty in 2016. Based on an INS/GPS-aided mid-course with terminal phase using an active/passive seeker, the missile guidance package was enhanced through an Indian industry-provided multiple-satellite navigation system utilising US GPS, Russian GLONASS and Indian GPS-aided Geo-augmented satellite constellations. Indian industry is also developing a new-generation seeker. With an identical missile configuration for land, sea and subsea platforms equipped with vertical (or inclined) launchers, the BrahMos entered service with Indian Navy in the anti-ship missile version in 2005, followed by Indian Army in land-attack mobile configurations. The BrahMos joint-venture has developed and tested longer-range capable land-attack and naval versions, thanks mainly to fuel-management system software adjustments, which allow more than 400 km range, a capability reportedly being extended to in-service munitions. Longer-range, higher speed (up to 7 Mach) and smaller versions, the last for airborne and submarine applications, are being trialled or under development. India is also developing the NIRBHAY subsonic cruise missile to be deployed by all armed forces.

The Chinese Government and industry are marketing export versions of the ASCM specifically for land-strike applications, providing insight into national capabilities in addition to the limited information on SLCM capabilities. As the MTCR treaty limits the export version's range, the national version could or can have a longer range. The CASIC indigenous defence group is offering a CM-602G land-attack derivative that can also be launched from ships, of the C-602 subsonic ASCM, in service with PLA Navy as YJ-62. With a 290 km range and a 480 kg warhead, the CM-602G has a baseline INS/GPS guidance fit with optional man-in-the-loop. In 2016, CASIC unveiled the indigenously developed CM-302 ASCM capable of 1.5-to-3 Mach speeds, which is closely related to the in-service YJ-12, offering a 280 km range with a 250 kg warhead. The CASIC development for the PLA Navy of the three-stage JY-18 with supersonic speed in the terminal phase and a reported range of 537 km, being similar in design to the Russian KALIBR weapon system, could lead to a subsonic SLCM development. In the latter sector, the new Type 55 destroyer is reported to be armed with a vertically-launched ASCM version of the ground-launched DH-10/CJ-10 land-attack subsonic cruise missile with 2,000 km range.

Naval Land-Attack Capable Missiles

Entered in service in late 2010 and today under delivery to or equipping eleven customers including the French Navy, the MBDA MM 40 Block 3 missile version continues to attract new customers such as the Qatari Emiri Naval Forces, which ordered in 2016 an important number of rounds for both ship- and coastal defence-based applications. Characterised by an airframe shorter than 6 metres (with booster) and a 780 kg weight, the Block 3 version features a powerful Microturbo TRI-40 turbojet providing an extended operation range of around 200 km. In addition to an active RF seeker, the advanced hybrid INS/GPS navigation package allows for the programming of 3D waypoints, optimised trajectories and simultaneous terminal attacks for multiple missiles on both sea and land-based targets. MBDA is however working to further enhance the EXOCET missile family's capabilities to cope with current and future operational scenarios and threats.

A new, next-generation version of the SAAB Dynamics RBS 15 ASM was awarded by Swedish Defence Materiel Administration (FMV) in March 2017 to equip the Royal Swedish Navy's VISBY class corvettes and Air Force's JAS GRIPEN E multirole fighters. Externally similar to current generation RBS 15, the new missile is reported to be a re-architectured development of the existing RBS 15 Mk3 anti-ship missile, introducing technology enhancements in the airframe, navigation suite, on-board processing in addition to the RF seeker to improve the all-weather capabilities and develop a significant range enhancement. The latter is reported to have been achieved thanks to a lower weight obtained mainly by composite material use in the airframe design.

The new RBS 15 version for both ship- and airborne applications will be operational from the mid-2020s. Jointly produced and marketed by Saab, Sweden, and Diehl BGT Defence, Germany, the current RBS 15 Mk3 is in production, under delivery or in service with the Swedish, German, Polish and reportedly Algerian navies. With a range of 250+ km, all-weather and fire-and-forget capabilities, the 4.35-metre-long and 660 kg (flight weight) Mk3 version is equipped with a high-resolution radar seeker, intelligent processing and a state-of-the-art navigation system with GPS.

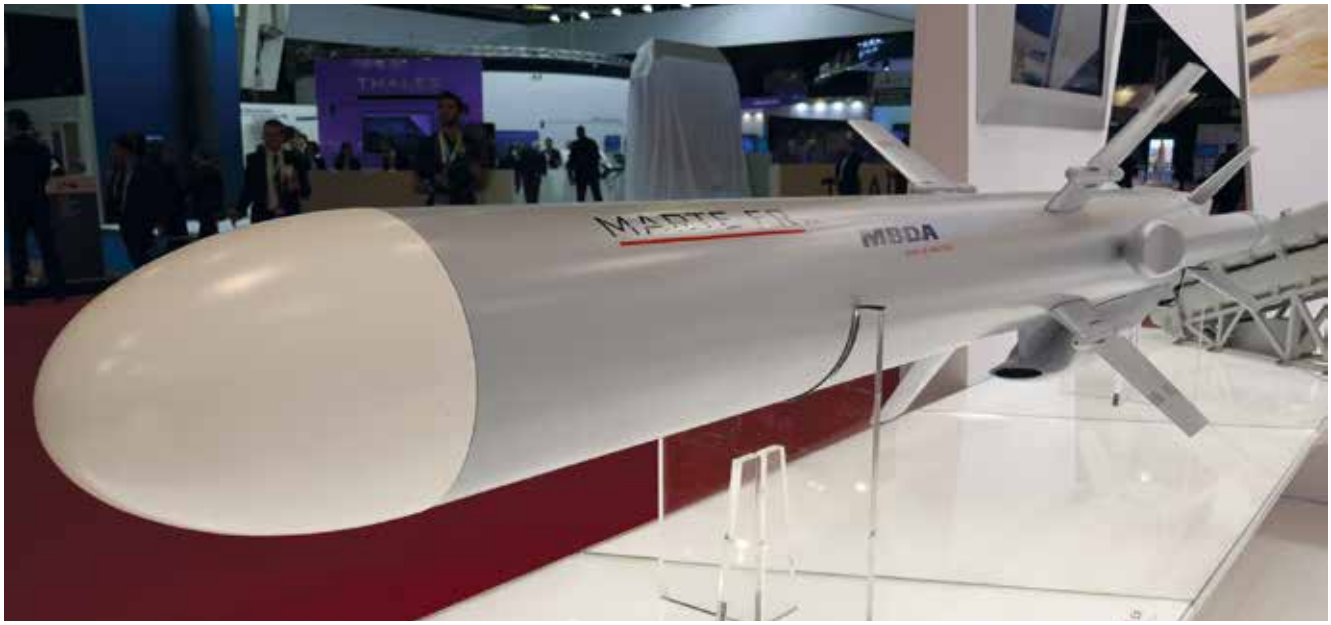
Kongsberg and Raytheon groups is offering the NSM on the US market and participating to the over-the-horizon weapon system (OTH WS) anti-ship programme for the US Navy's LCS and new FFG applications.

Having achieved initial operational capability in 2002 and in service with 29 international customers, the multi-platform-launched Boeing Defence AGM-84N HARPOON BLOCK II differs from previous missile versions by incorporating GPS-assisted inertial navigation, enabling the weapon to have both anti-ship and land-attack capabilities as well as new weapon launch control equipment. Building on the latest air-launched BLOCK II+ version for the US Navy's aviation and incorporating new INS/GPS guidance and new strike common weapon data link (SCWDL) offering man-in-the loop capabilities, Boeing is today working on the so-called HARPOON Block II+ ER missile concept, previously known as HARPOON Next Generation for surface applications. The ship-launched BLOCK II+ ER would build on the AGM-84N enhancements together with a more efficient turbojet engine and a lighter but more lethal warhead, approximately extending the range to 130 nm or doubling the current Block 1C capabilities.

Based on an intermediate-range anti-surface multi-platform weapon requirement capable of operating in both littoral and blue-water scenarios, the MBDA Italia MARTE Extended Range (ER) development, test and production programme gained momentum after the Qatar Emir Naval Force contract award in September 2016 for the supply of a coastal defence system based on the new missile and EXOCET MM 40 BLOCK 3 weapon. Resulting in a 3.6-metre-long and 315 kg missile with a Williams International turbojet propulsion system to achieve an effective range of well beyond 100 km, a GPS-aided navigation and guidance suite based on a radar seeker and making extensive use of naval MARTE Mk2/N qualified equipment, the MARTE ER is however at the centre of a new technologies insertion roadmap, including a lethal package enhancement (guidance, seeker and warhead). The current and future MARTE ER technologies are expected to form the core of MBDA Italia's new generation OTOMAT/TESEO anti-ship weapon system for the Italian Navy, which has issued new requirements for the future missile development, funding permitting.

To respond to the US Navy's over-the-horizon weapon system (OTH WS) anti-ship programme, Lockheed Martin has developed and tested a shipborne version of its AGM-158C Long Range Anti-Ship Missile (LRASM). Being a derivative of the AGM-158B JASSM-ER air-launched cruise missile, the LRASM is equipped with a new sensor package specific to the ASuW mission and was selected by the US Navy for the air-launched Offensive Anti-Surface Weapon (OASuW) Increment 1 programme to equip both the USAF's B-1 and Navy's F/A-18 E/F. Armed with 453 kg penetrator and blast-fragmentation warhead, LRASM employs a weapon data link, an anti-jam GPS, and a multimode passive seeker suite with autonomous target recognition. In addition to a surface-launched variant of the Mk 41 VLS, Lockheed Martin has developed a deck-mounted angled launcher which uses the same VLS-launched missile configuration centred on a jettisonable Mk 114 rocket booster. ■

Photo: Luca Peruzzi



MBDA Italia's MARTE ER

Developed by Kongsberg Defence & Aerospace Missile Systems division to meet the Royal Norwegian Navy's requirements, the highly discriminative, low-observable, sea skimming Nytt SJØMÅLSMISSIL/Naval Strike Missile (NSM) able to operate in both blue waters and littoral environments, differs from most competitors by having an advanced passive guidance package, which combines GPS-aided navigation with a dual-band imaging seeker with autonomous target recognition and selectable aim point for terminal guidance. With a 3.96 metres-long and 407 kg heavy composite-made airframe and range in excess of 200 km, the NSM comes with inclined launchers but has been studied also for shipborne-VLS and submarine-tube launched applications. In service or ordered by Royal Norwegian, Malaysian and Polish navies for shipborne and coastal defence applications, the NSM became part in February 2017 of German and Norwegian long-term cooperation in the naval sector with planned cooperation on further missile development and procurement by German Navy. The industrial teaming between

Boarding Team Evolution

Stefan Nitschke

The hybrid threats at sea in the wake of the migrant crisis in the Mediterranean require new measures to enable concerted action by state and non-governmental security organisations.

Accordingly the demand for improved armament, including better ammunition, but also for field-tested command and communication equipment, lightweight ballistic protection and miniaturised detection and position detection sensors is growing.

Growing Threats

As the crisis of migrants in the Mediterranean region is expected to continue throughout 2018, action by military and non-military organisations will continue to be necessary to counter the increasing hybrid threat of piracy, smuggling and trafficking in human beings. Ana Cristina Jorge, head of the Joint Operations Unit of the Frontex agency in Warsaw, Poland, since November 2012, stated in a presentation at MS&D 2016 in Hamburg that the situation in the Mediterranean region is associated with a major challenge: the increasing smuggling of migrants.

"At the moment, we have very much a network system for increased inter-agency cooperation, so we can contain this type of evolving crime in the region," she noted. According to Frontex, irregular migration is mainly facilitated by EU-based and/or internationally organised criminal groups, with migrant smuggling being a profitable and low-risk crime. To combat this criminal challenge, Jorge said, the "new Frontex" will receive coastal protection support, including the use of onboard parties. She pointed out that military and police cooperation can interrupt human smuggling and other criminal activities at sea. Since then, the NATO member states contributing naval platforms and personnel have been integrated into Frontex's existing operational structures to ensure a smooth exchange of information.

Photo: Stefan Nitschke

The new helmet camera offered by VTQ Videotronik GmbH for boarding party operations contains a colour and thermal camera in a compact and lightweight aluminium housing.

Author

Stefan Nitschke, is Editor-in-Chief of the German magazine "Wehrtechnik".

Reducing Deficiencies

Boarding teams, which are primarily operated by naval forces and law enforcement agencies, require "ready-to-use" equipment to handle the complex deployment scenarios. The former commander of the German SEK-M (Specialised Forces Navy), Captain (so-called) Stephan Plath, said that the operational success of the battalion-sized unit, a strong troop of combat swimmers, mine cleaners and boarding teams, depends heavily on new equipment and technologies in the industry. "We are constantly improving our capabilities by acquiring innovative products available on the market. This requires a careful analysis of what is available and which of our partners (in NATO) have similar requirements," he said.

Photo: Royal Netherlands Navy

Netherlands Maritime Special Operations Forces personnel enter a suspicious vessel from their fast raiding, interception and special forces craft (FRISC) using Henriksen's GIRAFFE TRACER pneumatic pole combined with a tactical rope ascender. Subsequent operators use wire ladders. Note the 9mm Glock 17M Para.

The first is protection. Improved ballistic protection helps the boarding teams to survive in the event of an attack. DSM Dyneema, manufacturer of DYNEEMA, the world's strongest fibre based on Ultra High Molecular Weight Polyethylene (UHMWPE) polymers, developed a ballistic combat helmet called FAST (Future Assault Shell Technology). Another product, ENDUMAX from Teijin Aramid BV, a former division of Akzo-Nobel and a member of the Japanese Teijin Group since 2000, is described as the material of choice for modern protective equipment. Endumax, which is also made from UHMWPE polymers, is eleven times stronger than steel for the same weight, while its stiffness is comparable to that of carbon fibres, says Gert W. Frederiks, President and CEO of Teijin Aramid BV. Combined with

ARMAMENT & TECHNOLOGY

Photo: Cobham Defence Communications

The Maritime Interdiction Operations System (MIOS) provides secure situational awareness, navigation, and blue force tracking for boarding party operations.

Teijin Aramid's light and flexible Twaron materials, ENDUMAX lightweight panels provide ballistic protection for the highest demands on protection and low weight.

Secondly, awareness and communication. The ability of commanders on land or on board a "mother ship" to pass information to boarding teams can dramatically improve the speed of operations, as documents, images and video images from remote commanders can be analyzed more quickly. Recent reports support the view that the security organisations are fully aware of their shortcomings in the area of onboard competence and are taking measures to remedy these shortcomings.

Photo: Safran

The encryption capability of the MorphoTablet 2 biometric tablet comprises an embedded processor to protect sensitive data, file systems, and communications channels, while a card reader serves as a secondary secure element and "integrated safe" for cryptographic keys.

ATLAS Elektronik GmbH teamed with VTQ Videotronik GmbH to push a new communications solution for securely transmitting audio and video signals obtained from boarding teams. The prototype system – called Mission Video Scout – was presented in 2016. It helps operations staff on board a mothership "monitor the mission of the boarding team" (by video monitoring) and "control its actions directly by providing tactical and operational instructions," according to ATLAS Elektronik's Uwe Sandhoevel. At the core of the system is a personal kit, consisting of a body-worn transceiver and a helmet camera unit (TV plus infrared). According to ATLAS Elektronik, the battery pack offers an operation time of up to four hours. VTQ Videotronik GmbH also offers its new helmet camera, which a company representative at Eurosatory 2018 describes as a tailored solution to improve situational awareness, accelerate decision-making processes and coordinate teams.

Another solution is Cornet Technology's TVCS INTERCONNECT 60R, a six-slot compact communications gateway designed to fit into a variety of boats and craft. INTERCONNECT'S on-demand 'any-to-any' connectivity feature is essential in supporting users – from warfighters to boarding teams – with full situational awareness and public safety emergency communication applications.

LS telcom AG in Germany has gone one step further and has developed LS OBSERVER, a system for monitoring the radio spectrum that helps border control authorities to detect and contain unauthorised activities of smugglers and terrorists. LS OBSERVER includes stationary, mobile, transportable, portable and airborne devices. The integration of geolocation and bearing functions such as Time Difference of Arrival (TDoA), Field Strength or Angle of Arrival (AoA) enables naval/maritime and law enforcement agencies to locate the source of illegal transmissions. With this instrument, they will be able to identify sectors where illegal transfers are frequent and where intensive monitoring is necessary.

Last May, the MarketsandMarkets "Fingerprint Sensors" market report suggested that biometrics and in particular fingerprint technology will be increasingly adopted in mobile applications like boarding party operations. The steadily growing demand for this technology led Safran's subsidiary Morpho to intensify its efforts to supply law enforcement units with handheld biometric terminals for analysis of fingerprints and facial imagery, with wireless connections enabling rapid data dissemination for further processing and dissemination. The company's MorphoTablet is one example of this trend. It enables boarding teams to better identify individuals and collect various biometrics, fingerprint, and facial recognition. The device can connect to Bluetooth, 3G or Wi-Fi allowing for immediate data exchange and live online verification.

Filling Capability Gaps

Boarding party operations also benefit from innovations in the field of small-calibre weapons and ammunition. There are several interesting manufacturers, including: Česká Zbrojovka (offering the CZ 805 BREN A1/A2 5.56x45mm NATO modular automatic rifles, where the A2 carbine is a more compact version of the modular A1 assault rifle in 5.56x45mm NATO calibre, from which it differs by a shorter barrel), FN Herstal (marketing the FN SCAR family of assault rifles available in 5.56 and 7.62 NATO calibres that are easily swapped between short CQC) and standard configurations); Heckler & Koch (promoting the DMR762-MR rifle); Kriss Systems (offering the Kriss VECTOR family of recoilless weapons); SIG Sauer (offering the MCX); and RUAG Ammotec. The latter developed the .338 LM/8.6x70 Swiss P Subsonic ammunition that can be individually adapted to different weapon types, including Accuracy International's 338AWM. A unique feature of this ammunition is that filling of

Photo: Tampa Yacht Manufacturing

The 50-FAC is suited for patrol, surveillance, and boarding missions in shallow coastal and riverine waters, and it is capable of achieving a top speed of 45 knots with a sustained cruising speed of 35 knots.

the cartridge and bullet configuration are individually matched to the weapon system concerned. The maximum operative range of the .338 LM/8.6x70 Swiss P Subsonic is 300 metres.

In the field of optics, vhf defence GmbH introduced the RAUBTIER (Predator) range of military grade thermal imaging cameras. Their intelligent processing algorithms constantly analyse the captured scene and adjust the camera's parameters to provide a natural-looking image, similar to that of a black and white camera, and ensures no information is lost in an over- or under-exposed representation. Photonis Night Vision offers the NOCTURN night vision camera available in a colour NOCTURN and an EB-CMOS (electro-bombarded CMOS) variant. The NOCTURN CMOS camera is a rugged camera module that provides monochrome real-time imaging capabilities – from daylight to bright starlight – in the visible and near IR spectrum.

There are situations where the use of "a weapon that is explicitly designed and primarily employed to incapacitate or repel persons or to disable equipment, while minimising fatalities, permanent injury, and damage to property and the environment" (NATO definition) is definitely preferable to the use of traditional (lethal) weapons. As to boarding party operations, there are two main roles for non-lethal weapons (NLW): constabulary role against pirates, traffickers, smugglers, poachers, and more; non-cooperative boarding that is quite comparable to many police and army riot control requirements.

Newco Safety Technologies GmbH has developed a type of tear gas – NMI (Nano Molecular Irritation) EPIPHORA 15' – that is based on a nanomolecular agent. It uses the CS gas invented in 1923, diluted in a solution, and released with a novel output system. By emitting the irritant with the help of the evaporisation of a dissolved gas, nanoparticles are created, causing intense irritation for a period of between 15 and 20 minutes. The NMI EPIPHORA 15' irritant can be applied in different configurations: spray (80 ml, 150 ml, 400 ml); backpack, high-pressure system; grenade; 40 mm LV muzzle blast; 40 mm LV cartouche; 76 mm cartridge; and active vehicle protection.

An Array of Designs

More recent naval/maritime Special Forces operations underscored one tendency: the need for heavy-duty inflatable boats (RIBs/RHIBs) and high-speed interceptor craft (HSIC) to better cope with fast-running threats. More recent international orders of new-generation RHIBs are a testament to this development. The Finnish boatbuilder Boomeranger Boats delivered a new 9.2 m Special Operations craft to the Royal Swedish Navy to operate from the 3,550-tonne (full load) minelayer HMS CARLSKRONA (M04) during her deployment as part of the EU Operation ATALANTA. The craft is equipped with a single-point lifting device for quick launch and recovery at full load. Additionally, the Finnish Navy's Special Forces were in the process of complementing their fleet with new second-generation 12 m Special Operations craft from Boomeranger, with the RHIB equipped with heavy machine guns and advanced electro-optical/infrared (EO/IR) sensors.

Part of a multitude of manufacturers offering fast and high-speed craft for boarding operations, Tampa Yacht Manufacturing based in Pinellas Park, Florida, manufactures a great variety of coastal survey boats, air-droppable RHIBs, fast boarding craft, fast coastal interceptors, and riverine combat craft made from carbon fibre-reinforced all-composite materials. Tampa Yacht's CEO Robert Stevens noted that the 50-FAC is a monohull form of the deep-vee type designed specifically for interception, boarding, and Special Forces Operations. With a minimum range of 740 km at wide open throttle and a cruising range of 925 km, the craft is a very capable and effective, purpose-built craft optimised for maritime security operations in the littorals. Seating is available for four crew and twelve troops. The craft employs twin inboard MAN R6 800 hp diesel engines and an ULTRAJET waterjet propulsion system. The variety of mission craft produced by Tampa Yacht are fitted with varying levels of ballistic protection (e.g. Level 3A ballistic protection utilising Dyneema fibres), fixed and remotely-operated weapon

Photo: SIG Sauer

The MCX, available in multiple calibres, is being considered by several naval/maritime Special Operations Forces elements.

mounts, and customer-specified C4ISR, electronics, and sensor suites. Available options also include an autopilot with joystick steering, a bowthruster with joystick control, and FLIR (Forward Looking Infrared) camera systems.

As a high-speed run on choppy seas can cause severe strain on the human body (often resulting in injuries and certainly in fatigue and stress), suspension seats and shock mitigation seats enable crew and operators to face an otherwise dangerous situation. The world leader in that niche is the Swedish company Ullman Dynamics, whose seats can be found on most of the high-speed craft in service with coast guards, navies, and Special Forces.

Making Boarding a Success

Harnesses, aramid-strengthened ropes, tactical and marine boarding ladders, boarding hooks, grapnels, and grapnel launchers are required by boarding teams to operate

Photo: Cobham Defence Communications

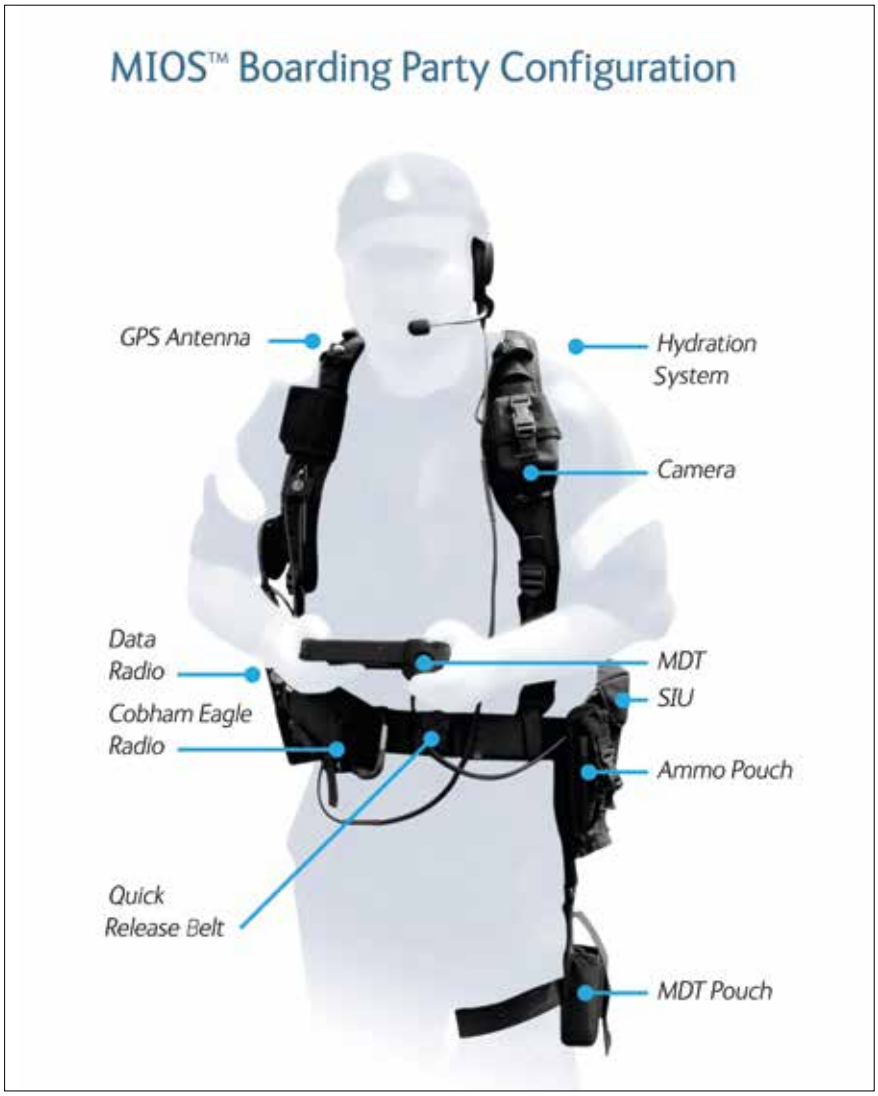


Photo: H. Henriksen AS

Each rung of the Carbon Multi Ladder is 45 cm wide, permitting rapid and safe ascent by heavily laden personnel.

under extremely severe conditions. "They enable them to quickly deploy from rotary-wing aircraft or to conduct boarding operations, offering superior safety during descent," Volker Niebergall, CEO of N+P Nierbergall+Partner, noted. The company's VLAUNCHER, powered by pressurised air, projects grapnels made of high-strength aluminium to a minimum height of 50 m and horizontally up to 80 m, enabling Special Forces to quickly enter ships.

Tactical ladder technology took a step forward with the launch of Norwegian Special Forces and rescue equipment manufacturer H. Henriksen's new Carbon Multi Ladder (CML) designed for both marine and urban boarding and entering operations, the first orders for which the company reported in September 2015. A product of the company's REBS division, the CML is a multifunction ladder that assembles from carbon-fibre sections moulded using advanced techniques derived from those used in the high-performance bicycle industry to produce a very strong monocoque frame. Users can stack up to five sections for a total length of 4.5 metres. It can be leaned against a wall or suspended from hooks and also used as a horizontal bridge, for which there is a bracing wire, a capability that could be useful for crossing gaps between containers aboard a ship, for example, and as a stretcher. Each section weighs 1.5 kg and measures 0.95 m in length. In hook-suspended configuration, it will support 1,000 kg, said the manufacturer. The CML packs into a small package easily carried in its dedicated backpack.

Conclusions

There has never been so much technology available to help naval/maritime Special Forces, boarding parties, and law enforcement agencies gather intelligence, identify, and survive. With many European countries at increased levels of alert against migrant, drug and weapon smuggling, illegal border crossings, and other unlawful activities, equipment choices like those discussed in the present report are becoming an important focus of attention. ■

Innovation in the Ops Room

Luca Peruzzi

The pace of innovation in the maritime battle space, particularly in the anti-surface and anti-air domain, has been intensified by operations in cluttered littoral environments, which are part of most of today's naval missions.

Although information exchange via data link has helped to complete the tactical picture in real time, the amount of info presented by the Combat Management System (CMS) to personnel in the operations room/combat information centre (CIC) needs to be decluttered and shared among the team to enhance situational awareness and mission accomplishment. Both navies and industry are involved in human-machine interaction and space management innovations in the CMS; in addition, most services have to deal with crew numbers reduction, the younger generations' different attitude to technology, and reduced procurement and maintenance budgets.

Photo: F. Dekker-Branbuilders/Thales

With the BASELINE 2 TACTICOS CMS, Thales Nederland introduced a new MOC Mk 4 multifunction console (MFC) to ensure clear lines of vision in the ops room with a workflow-oriented human-machine interface (HMI) and a multi-screen collaboration wall.

TACTICOS

The latest addition to the family of more than twenty navies using the Thales Nederland-developed TACTICOS CMS is the Indonesian Navy (TNI-AL) on board the two new SIGMA 10514 PERUSAK KAWAL RUDAL (PKR) frigates, the first of which was delivered in February 2017. The latter programme is the first complete integration of the new BASELINE 2 TACTICOS CMS. The Algerian Navy was the first to receive TACTICOS BASELINE 2 solutions for Thales Nederland SMART-S Mk2 3D air/surface surveillance radar and Link Y operational control and associated new multifunction consoles/TACTICOS cluster only, all integrated within a Chinese-supplied CMS on board the new Chinese-built C-28A Cass corvette. However, the Indonesian Navy's PKR programme is the first full integration of the latest and updated TACTICOS hardware/software configuration, known internally as BASELINE 2. To overcome the limitations of the crowded ops rooms and move from situation awareness to 'situation understanding' and towards 'situation prediction in near-real time', as Thales Nederland put it, the company introduced the new MOC Mk 4 multifunction console (MFC) designed to ensure clear lines of vision in the operations rooms/CIC, a new workflow-oriented human-machine interface (HMI) that offers improved decision support to the operator, and a multi-screen 'collaboration wall' on the ops room bulkhead. According to Thales, the intuitive and user-centric new TACTICOS HMI is easy to handle and offers improved clarity in both presentation and function. The operator's roles and tasks are organised in pre-defined worksets at each console. A common graphical user interface look and feel is maintained throughout. The new HMI is implemented on a new MOC Mk 4 console or 'team station', featuring a large 30-inch HD display, a reduced footprint and an easy-to-view display to provide an uninterrupted field of view through the ops room, and it comes with a combination of joysticks, track balls or mouse-type interactive devices. The new workflow-oriented HMI gives the operator only the information relevant to the task in hand, and it uses 'intelligent automation' to anticipate the operator's logical next step in the workflow sequence. Thales chose Quick Entry Keys (QEK) instead of touch screen displays as input devices. The low-profile MOC Mk 4 console design allows operators to maintain an unobstructed sightline to the team-centric collaborative command information wall on large screens. The first BASELINE 2 application for The Indonesian Navy's PKR frigates has the new consoles (10 in total plus the command office's chair placed behind them) arranged in two banks facing the bulkhead-mounted collaboration wall. BASELINE 2 can be applied to each of the seven Thales scalable suites, starting from TACTICOS 100 for littoral security operations to TACTICOS 1000 for high-intensity multi-warfare military operations with an additional theatre missile defence capability.

9LV

With more than 230 systems delivered worldwide, Saab Combat Systems and C4I Solutions is continuing to improve its family of 9LV CMS for both surface and submarine platforms. Among main customers such as the Royal Swedish Navy, the latest 9LV iteration and its subsystems have be-

come the most widely used CMS including Royal Australian Navy platforms such as the new two CANBERRA Class LHDs and two supply vessels as well as a candidate for the future ASW frigates in the scope of the SEA 5000 programme to replace the ANZAC frigates, also equipped with 9LV CMS, which had been subject to the recently completed ASMD (Anti-Ship Missile Defence) mid-life upgrade. Saab has also been selected as a potential supplier for the Canadian Surface Combatant programme after participating in the HALIFAX Class upgrade programme, providing modules for the CANACCS 9LV CMS package, in addition to the 9LV fire control system. A focus on teamwork and collective understanding in the ops room is, among other improvements, at the heart of Saab's latest 9LV CMS product.

Photo: Australian Defence

Saab's latest 9LV CMS displays all relevant information on a single large screen console, featuring a 30-inch HD display and a 15-inch table-mounted touch screen.

Saab investigated situation awareness and communication among the command team in the CIC. Based on its findings, Saab has developed a range of solutions to meet these requirements, from optimising the layout and organisation within the ops room to improving console infrastructure. Saab is leaning towards a 'classroom' layout, with consoles facing a video display on the bulkhead and the senior commanding staff in the back on elevated stations to control the entire picture for surface combatants.

For less complex operations-oriented units, such as offshore patrol vessels, Saab is looking to integrate CIC functions into the bridge. Saab is leaning toward a real-time war fighting solution where the operator has all information available on a single large display. The company's latest 9LV CMS iteration uses a compact design featuring a 30-inch HD display and a 15-inch table-mounted touch screen input device. Saab has not made use of touch screen technology in the main display due to the distance of the angled desktop screen, but it is proposing a Single Touch Screen Console (STC) which combines the latest 9LV software solution with HMI-based touch screens distributed across the ship's compartments. Saab is also continuing to invest in display techniques; the company just came forward with a new 3D-aware chart engine similar to NASA's WorldWind open source software, which allows for the quick and easy generation of 3D visualisations of maps and geographical information. For the Thai customer, Saab has also developed a conference console using a single keyboard and single-touch inputs, which could evolve to become part of a multi-touch operation console.

Photo: Crown Copyright 2016

BAE Systems produces the Royal Navy's CMS systems – the OUTFIT DNA(2) fitted to Type 23 frigates and amphibious platforms, and the CMS-1 system for the Type 45 destroyers and the QUEEN ELIZABETH Class aircraft carriers.

OUTFIT and CMS-1

As the sole supplier of CMS for the UK Royal Navy, BAE Systems' Naval Combat Systems team is leading the efforts to apply a shared computer environment (SCE) as a common processing infrastructure to Royal Navy (RN) surface ship combat systems, after applying it to the underwater fleet. BAE Systems provides the two in-service CMS systems – the OUTFIT DNA(2) system fitted to the Type 23 frigates and being refitted to the RN's three major amphibious platforms, and the CMS-1 system fitted to the Type 45 destroyers' and QUEEN ELIZABETH aircraft carrier's combat system.

Thanks to its scalable architecture, CMS-1 also equips the BAE Systems-built OPVs for both the Royal Navy and export customers. As part of a wider drive towards a common core combat system across the fleet to replace diverse system designs, the UK MoD is widening the 'shared infrastructure', which introduces common processing and a more open system, facilitating technology refreshing and system updates.

BAE Systems is currently working to apply the first new Surface Common Combat System (SCCS) version to Type 23 frigates, while Thales and QinetiQ are cooperating based on earlier SCE technology for the Royal Navy's flagship HMS OCEAN, an amphibious assault ship classified as a helicopter carrier (LPH), in parallel to the DNA(2) CMS installation. The latter provides for a shared infrastructure for all platforms and their OUTFIT DNA(2) command systems plus new software to smoothen integration on board the Type 26 frigates. A common infrastructure will advance these platforms as they can then rely on a large information-processing cluster capable of sharing applications and capabilities, as BAE Systems put it. Thanks to the concept of application brokering, an operator will be able to log into the shared infrastructure and access applications relevant to his role from consoles or other access points throughout the ship. This will significantly reduce the hardware footprint and weight of the platform, heat and noise in the ops room (thanks to deleting computers on each console), and maintenance and life-cycle costs. SCE technology might also be applied to CMS-1-equipped new platforms, including Type 45 destroyers and QUEEN ELIZABETH

Photo: Naval Group

For GOWIND corvettes, Naval Group developed the Panoramic Sensor and Intelligent Module (PSIM) which incorporates the integrated mast with its various sensors and the operations centre with the SETIS CMS and associated technical rooms.

Class aircraft carriers of the Royal Navy and in export. Building on its experience with projects carried out for the UK MoD, QinetiQ is offering the ViewFinder CMS to customers worldwide.

SETIS

SETIS CMS was developed by DCNS (now Naval Group) for the French Navy's (FREMM) multi-mission frigate programme and is the result of the company's experience in developing integrated multi-mission combat systems. It was developed for heavily armed surface combatants. Thanks to its open and scalable architecture, and in addition to all FREMM customers including the French, Moroccan and Egyptian navies, the allegedly combat-proven SETIS is integrated on the GOWIND corvettes for the Egyptian and Malaysian navies; another enhanced version has been selected by the French General Directorate for Armament (DGA) for the future 4,250-tonne FRÉGATE DE TAILLE INTERMÉDIAIRE (FTI), which was developed by DCNS with Thales and other French companies and unveiled at Euronaval 2016 by the French Minister of Defence. Although there is no official confirmation, the SETIS CMS system has reportedly been offered by the CMN Shipyard (Privinvest group) to equip the COMBATTENTE BR 71 Mk II corvette for an export customer. SETIS CMS is modular and multi-mission capable and benefits from FREMM and GOWIND programme developments; it has an open architecture, an intuitive human-machine interface and a wide range of reusable functional components to meet customer needs. Built to address current and emerging threats, SETIS integrates force multipliers such as unmanned systems directly operated from the CMS to strengthen the ship's survivability, a decision-making command support system (CSS) and provides full interoperability and networked operations with NATO-standard data links in addition to cyber defence modules to secure communication and information systems. Naval Group also offers NextGen CIC technologies to facilitate operator integration into the chain of command and exploit the full potential of control systems by providing an easily accessible and collaborative information exchange environment.

In order to meet the needs of navy and coast guard for surveillance missions and littoral zone protection, Naval Group is promoting the marine-proven POLARIS system, which has already demonstrated its capabilities on board the OPV 90 L'ADROIT operated by the French Navy in anti-piracy operations and in routine missions of national interest. Based on a scalable, open architecture and qualified for the operation of unmanned systems, POLARIS can both undertake maritime surveillance missions and engage asymmetric surface threats. The system is already in service on the French Navy's corvette and patrol vessels, while a system module is used on amphibious MISTRAL class platforms to strengthen self-defence capabilities.

Photo: Naval Group

Naval Group developed the SETIS CMS for the French FREMM frigates and for export markets. The scaleable and open architecture CMS also found applications on smaller GOWIND corvettes.

ATHENA

ATHENA (Architecture & Technologies Handling Electronic Naval Applications) is Leonardo's CMS solution based on a redundant, modular and scalable architecture that can be adapted to specific customer needs. Early ATHENA CMS systems were integrated on the Italian Navy's COMANDANTI Class OPVs, the MAESTRALE Class frigates, the AMMIRAGLI Class destroyers' mid-life upgrades and the HORIZON Class AAW destroyers.

The latest and third generation of ATHENA CMS was developed by Leonardo for the Italian Navy's CAVOUR STOVL aircraft carrier and the FREMM multi-mission frigates; it was also sold to international customers including the UAE Navy's BAYNUNAH Class ASW corvette, the FALAJ 2 stealth patrol vessel and the GHANNATHA fast patrol boats, the Lithuanian Navy's FLYVEFISKEN Class OPVs, and the Algerian Navy's BDSL amphibious and command support vessel. Characterised by multifunction consoles with two or three screens, Leonardo's ATHENA family has evolved into an M-DLP multi-data links system (Link 11, 22, 16 and VMF), and advanced AAW (Anti-Air Warfare) functionalities have been added to provide ballistic missiles defence (BMD) capabilities.

Photo: Luca Peruzzi

For the Italian Navy, Leonardo developed a new CMS console with a 43-inch HD colour touch screen with a lightweight carbon-fibre structure.

Such developments have emerged as part of a fleet renewal and expansion programme recently launched by a Gulf Cooperation Council country. This programme includes four 107-metre multipurpose corvettes equipped with MBDA SAAM ESD (Extended Self-Defence) ASTER 30 Block 1 ammunition-based ground-to-air guided missile systems with Leonardo's GRAND KRONOS Naval AESA multifunctional radar, two 60-metre patrol boats and an amphibious and command support vessel.

Photo: Navantia

Navantia Sistemas is the combat systems integrator for the Spanish Navy and has developed the SCOMBA CMS, which is the standard for the latest-generation Spanish Navy ships and submarines.

SADOC 4

In order to reduce the life-cycle costs of a hardware- and software-based CMS and to introduce solutions for platform and battle management, the Italian Navy commissioned Leonardo (together with Fincantieri, where Leonardo operates as a system integrator and supplier of combat systems) to develop and integrate a fourth generation CMS (Sistema Automatico per la Direzione delle Operazioni di Combattimento or SADOC 4 under the Italian Navy's designation) and a new combat bridge (PLOC, Plancia Operativa di Combattimento).

According to a presentation by the Italian Navy at the Naval Mission Systems Technology 2016 conference hosted by the SMi Group in Rome last November, the new-generation CMS was designed as a cross-platform product with an open architecture and common software and hardware modules capable of meeting the needs of combat and support vessels, in the latter case with a reduced number of multifunction consoles (MFCs) and functionalities.

SADOC 4 is based on a Common Source Library (CSL) that contains all the Computer Software Component Items (CSCI) and the system configuration files which allow having a single installable and configurable CMS, reducing the cost of qualification, acceptance and software life-cycle management.

SADOC 4 is being developed in an incremental process in three builds, from a less developed system with functionalities for the new Logistic Support Ship (LSS), which will be delivered in 2019, to a sophisticated CMS for a multipurpose patrol ship (PPA, Pattugliatore Polivalente d'Altura) with full AAW, ASuW and ASW configuration and the Landing Helicopter Dock (LHD) to be delivered in 2024 and 2022 respectively.

In addition to a Common Source Library (CSL), SADOC 4 features industrial blade processing units in very compact racks (C3E, Combat Common Computing Environment) and a fully remote-controlled processing architecture for the MFC.

The latter is characterised by a lighter weight and a smaller footprint, thanks to a lightweight carbon fibreglass structure. Instead of the three-screen configuration, the new MFC is designed for new-generation personnel, with a single 43-inch HD colour touch screen display, with keyboard, joystick and trackball input options.

According to the Italian Navy, the new MFC offers a powerful, intuitive and transversal HCI (Human Computer Interface) level and, in addition to the integrated ship management system with only one touch screen display, also allows access to combat support systems (CSS) and unclassified networks.

Such a revolutionary development, which includes a newly developed touch table and mission display wall, will be accompanied by a new combat bridge on the PPAs. The new combat bridge, based on an aviation-derived, side-by-side cockpit housing two ship-pilot stations, supported by four single-screen MFCs and a command post with multiple monitors, will enable the six-man team (plus commander) to conduct ship navigation, operations and self-defence within a range of 25 NM.

Photo: Bundeswehr

In addition to the traditional tasks of national and alliance defence, the F125 Class frigates with the Atlas Elektronik ACNS CMS are designed for conflict prevention, crisis management and stabilisation operations.

SCOMBA

Navantia Sistemas, the systems department of Navantia, is the system integrator for the Spanish Navy and has developed the SCOMBA CMS (Sistema de COMbate de los Buques de la Armada).

As the standard for ships and submarines of the latest generation of the Spanish Navy, SCOMBA has been designed with a common infrastructure shared by all types of ships, as well as a range of applications tailored to the needs of the different mission profiles of the fleet, making them ef-

ficient, flexible and easy to maintain. A new generation of SCOMBA will be at the heart of the new F-110 multipurpose frigate combat system, the development programme for which was launched in December 2015 and runs until 2020.

According to a presentation by the Spanish MoD at the Naval Mission Systems Technology Conference in 2016, the adaptation of the SCOMBA CMS to the operational requirements of the F-110 includes the integration of new sensors and weapon systems and the addition of new functionalities, including net-centric and unmanned vehicles, as well as the application of the latest hardware and software technologies focusing on operational flexibility, survivability and life-cycle optimisation.

The F-110 will be equipped with a new-generation combat system which, in addition to the enhanced SCOMBA CMS, will include a host of new sensors and systems mainly housed on an integrated mast structure, including radar distributed/staring infrared search and track (IRST), EW and communication systems.

As part of the technology development programme PROTEC (Programas Tecnológicos F-110), awarded by the Spanish MoD to Navantia and the joint venture PROTEC F-110 founded by Indra, Indra is working on a new X-band fixed array radar, IFF, IRST, IRST, RESM, CESM, CESM, and, in conjunction with Lockheed Martin, on an S-band fixed-array surveillance radar. The enhanced SCOMBA will integrate USN/Lockheed Martin AEGIS elements based on the missile fire-control loop working the new S-band radar and the Standard SM-2 missile system elements (VLS Mk 41, AAW/Fire Control directors and missile), as well as new capabilities and technologies such as Link-22 and VMF tactical data link, next-generation navigation systems, C2 systems, helicopter and unmanned vehicle integration, reduced crew operation, hardware and software upgrades, and additional training capabilities.

Called CATIZ for export markets and with added functionalities to meet the requirements of other navies, a version of the current CMS, together with various sensors provided by Navantia and Indra, was recently commissioned by the Indonesian MoD to modernise the FATAHILLAH class corvette of the Indonesian Navy.

ANCS

With its F125 frigates, the German Navy has taken a step in the direction of a multi-role surface combatant. The new ships were developed for current and future deployment scenarios.

In addition to the traditional tasks of national and Alliance defence, the F125 frigates are designed for conflict prevention, crisis management and international intervention/stabilisation operations. The ships can remain in the deployment region for considerable periods of time (24 months away from the base's maintenance facilities); they project power through rapidly-deployed embarked special forces, long-range (100 km) and high-precision land attacks with 127 mm guns, embarked task force command and control facilities in addition to an asymmetric warfare self-defence suite, high platform survivability and an efficient electric propulsion, which doubles the running hours at sea compared to previous generation frigates. These capabilities are provided by a smaller crew, which is only half of the current frigate crew.

Atlas Elektronik's ANCS CMS adapts and manages the extended mission profile, including the precise and flexible engagement of enemy forces, tactical fire support from sea to land, special forces support, and asymmetric threats engagement. In addition to the CMS, Atlas Elektronik also developed the tactical data link system (ALiS) and modelled the combat system, and is responsible for integrating all its sensors and effectors.

The high degree of automation and the user-centred operating concept of ANCS allow for complex tasks to be fulfilled with fewer personnel. Its distributed architecture is the basis for the necessary redundancy and degradation capabilities to achieve the high level of combat survivability required for the F125 frigate.

ANCS consists of a robust software core with few interchangeable components, complemented by expanded capabilities that can be added in a modular way so that the system can be customised and configured to the respective ship class.

Photo: US Navy

Lockheed Martin's COMBATSS-21 has been selected by the US Navy to equip the Future Frigate programme.

Network-centric warfare capabilities are ensured by the Atlas Tactical Data Link System (ADLiS), supporting the transmission, reception and forwarding of tactical information over diverse data links (11, 16, 22 and including Simple).

Among the most recent CMS implementations, in 2015 Atlas Elektronik integrated a CMS into a MEKO 200 frigate of an undisclosed customer, probably the Algerian National Navy.

COMBATSS-21

Lockheed Martin's COMBATSS-21 CMS is supporting the US Navy's Littoral Combat Ship (LCS) and Future Frigate programmes. In addition to being the CMS in operation on the FREEDOM variant LCS, the COMBATSS-21 was selected by the US Navy in August 2016 to equip whichever variant is chosen to meet the Future Frigate requirement, and Lockheed Martin will be the overall CMS integrator for the frigate programme. The contract awarded to Lockheed Martin includes the hardware and software development, integration and delivery of combat systems for the first two frigates, along with technical data packages to support an eventual backfit effort for Austal's INDEPENDENCE-variant LCS.

COMBATSS-21 (Component-Based TotalShip System-21st Century) rests on the

Photo: Danish MoD

Danish IVER HUITFELDT Class frigates equipped with Terma's C-FLEX CMS will offer true IAMD capability, delivering outstanding situational awareness for both AAW and BMD missions at the same time.

AEGIS Common Source Library (CSL), and shares pedigree with the AEGIS BASELINE 9 software developed for the AEGIS cruiser and destroyer fleet, as well as international ships, the AEGIS ASHORE system, LCS and the US Coast Guard National Security Cutters. The CSL allows surface combatants to rapidly and affordably integrate new capabilities across the fleet. According to Lockheed Martin, this means that ships using a CSL-derived combat system can incorporate new sensors, weapons and capability upgrades to keep pace with evolving threats. The benefit of the surface combatant CSL is that these updates become available for rollout across other ship classes. The Canadian subsidiary of Lockheed Martin has developed the CMS 330 combat management system, which has been selected as the core system for both the Royal Canadian Navy's (RCN) HALIFAX Class modernisation and the New Zealand Navy's ANZAC frigate systems upgrade, in addition to the RCN's new fleet of Arctic/Offshore Patrol Ships.

C-FLEX

With more than 25 years of C2 experience, the Danish Terma group supplies the mission-proven C-FLEX Command & Control system to navies and coast guards around the world. C-FLEX provides a common intuitive user interface with full Situational Awareness (SA) to improve decision-making. C-FLEX is a modular and scalable C2 system compatible with all C-Series products: C-SEARCH (SCANTER), C-FIRE, C-LINK, C-RAID and C-GUARD (SKWS), and with easy integration of third-party equipment. C-FLEX integrates all types of sensors, self-protection, weapon and communication systems into one intuitive system. In April 2016, Denmark's Defence Acquisition and Logistics Organisation (DALO) contracted Terma to study and support the Ballistic Missile Defence (BMD) and Integrated Air and Missile Defence (IAMD) programmes, because the Danish Government decided to upgrade at least one of the IVER HUITFELDT class frigates to a BMD sensor and offer this capability to the NATO BMD system. Thanks to conducted and future activities, the frigates' C-FLEX CMS will offer true IAMD capability, delivering outstanding situational awareness for both AAW and BMD missions at the same time.

GENESIS

Based on the GENESIS (Gemi Entegre Savas Idare Sistemi) open architecture CMS, developed initially by the Turkish Naval Forces Command and then migrated to Havelsan for further development and production, an updated version of the same system will be part of the MILGEM programme, which aims to develop an indigenous 2,000 tonne multirole corvette; Havelsan is the main system integrator and largest local subcontractor. Enhanced versions with network-centric warfare capabilities and other weapon and electronic system integration will equip the ISTANBUL Class frigates (previously MILGEM-G) and the new Turkish LPD class; the system is also being promoted internationally for both upgrade (such as PERRY Class frigates) and new shipbuilding programmes.

ENTCS-2000

Israel's Elbit Systems and IAI have developed CMS variants, with Elbit having delivered its ENTCS-2000 system to the Israeli Navy (SAAR 5 corvettes) and to the two LUPO Class frigates of the Venezuelan Navy. The ENTCS-2000 is based on an open, reliable, and distributed architecture and COTS building blocks. Modular design and scalability assure interfacing with organic UAS and USV designs and compatibility with a broad range of existing systems and platforms, from small patrol boats to frigates, centres ashore and airborne platforms. ■

Photo: Turkish Naval Forces Command

Havelsan's GENESIS CMS is at the heart of the Turkish Navy's combat ships.

"OCCAR stands ready to take the challenge"

Photos: OCCAR

Interview with Major General Arturo Alfonso-Meiriño, Director OCCAR-EA

ESD: This year, OCCAR commemorates its 20th anniversary. What were the reasons and the motivation to establish OCCAR as an international procurement agency 20 years ago? Who was involved? What were the objectives?

Alfonso-Meiriño: The Organisation for Joint Armaments Cooperation (OCCAR), whose Executive Administration I have the honour to lead, celebrates the 20th anniversary of the signature of its Convention by the governments of Germany, France, Italy and the United Kingdom, that took place on 9 September 1998. This Convention was then ratified by their respective parliaments in 2001, and by Belgium in 2003 and Spain in 2005.

The OCCAR Convention, which is based on the 1995 Franco-German "Baden-Baden Principles", assigned to that new Organisation the specific mission of promoting cooperation, improving efficiency and reducing the costs of armament procurement programmes. And all with the vision to become a centre of European excellence in the management of complex armaments programmes.

With a clear European vocation, referred to in its preamble and articles, and a strong support to the European identity of Security and Defence and to the strengthening of the European Defence Technological and Industrial Base (EDTIB), it pursued the industrial consolidation of the sector and the unification of the regulatory framework of the defence market in Europe – a market traditionally operated nationally and individually by European nations on the basis of "national security interests" and thus very much fragmented.

This European vocation needs to be framed in the historical context of 1998. At that time, the European Security and Defence Policy was still emerging, and far from "Common". Equally distant was the creation of the defence-related European institutions, such as the Military Staff of the European Union (EUMS), the Military Committee (EUMC), or the EDA. The OCCAR Convention also predates the involvement of the European Commission (EC) in industrial and defence market issues, made official with the publication in 2009 of its defence related directives.

ESD: In what way has the task spectrum of OCCAR developed and changed in the course of the 20 years of its existence? What services can OCCAR offer to non-OCCAR nations?

Alfonso-Meiriño: Twenty years after its introduction, the vision of the founding fathers of OCCAR, regarding the European identity of security and defence, has become a reality.

The evolution of the European Security and Defence Policy, now called "Common", has been unstoppable in recent years. The leadership of the EU Council in the more political issues of defence, and of the EC in those related to the defence industry and market, always in coordination with the European Parliament, are today a fact. An undeniable fact even for Eurosceptics, both traditional and those that have arisen on the political scene in the last electoral rounds of several Union Member States (MS).

Moreover, OCCAR has established itself as a true centre of excellence in its field of competence and has proven not to be a closed club. The participation of nations such as Lithuania and Slovenia in the 8x8 BOXER armoured vehicle programme is a good example.

With regard to our tasks, the Convention sets out that OCCAR can: perform management of assigned cooperative and national programmes, including In-Service Support (ISS) and research; contribute to the harmonisation of technical specifications; coordinate joint research activities and studies. However, since OCCAR received its legal status in 2001, it has consolidated its expertise in the development, production and ISS phases. Although all tasks can be accomplished, OCCAR is not active in research and technology that is of low technological readiness, nor the harmonisation of requirements, where the European Defence Agency (EDA) has a clear role.

ESD: What reasons are behind new nations joining OCCAR?

Alfonso-Meiriño: I believe the OCCAR business model holds some key differentiators that have helped OCCAR build its reputation as a centre of excellence.

The OCCAR model is based on a Central Office (CO) that supports the Programme Divisions (PDs) in all corporate issues. Moreover, the PDs are operationally autonomous, although always under the responsibility and supervision of the Director. Besides, the current size of OCCAR-EA, minimally hierarchical, allows a fast and effective admin-

The BOXER Programme provides the armies of Germany, The Netherlands, Lithuania, Slovenia, Australia (shown) and perhaps in future the UK with a new generation of all-terrain armoured utility vehicles.

istration of the corporate and programme aspects, and entails a very low administrative cost overhead of only 1.3%.
The supervision of the six MS in the management of the Organisation ensures the continuous updating and harmonisation of its legal and regulatory framework, and the rapid and efficient integration of new programmes, new phases in existing programmes or new Participating States (PS). In practical terms, it means that there is no need to go looking for common ground every time a new programme/phase/Programme Participating State is integrated.
The roles defined for the so-called Programme Boards and Programme Committees, in which representatives of each of the PS are integrated as customers, ensure total transparency and control over their respective programmes, protecting the joint and individual interests of OCCAR, as well as of the MS or non-MS.
This is what OCCAR offers to the non-MS. As you can see, the same rights and obligations in the programme they participate in, minimum overhead cost and total control.

ESD: Which future tasks resulting from PESCO initiatives could be accomplished by OCCAR?
Alfonso-Meiriño: On 8 December last year, the Council of the EU established the Permanent Structured Cooperation (PESCO). PESCO will allow MS, whose military capabilities meet higher criteria, to make binding commitments within the framework of the EU; on 6 March this year, this initiative materialised in 17 projects with diverse participation of 25 of the 28 MS of the Union.
The European Secure Software Defined Radio Programme (ESSOR) is one of the 17 identified PESCO projects and is being managed by OCCAR. It started in 2008 with the joint work of the governments of Finland, France, Italy, Poland, Spain and Sweden, and has recently entered the Operational Capabilities phase (OC1), without the participation of Sweden, but with the integration of Germany under way. This programme has an important requirement for interoperability and a clear European identity and is aimed at providing efficient communications at the level of army brigade and below, building a secure high-speed mobile ad hoc network. The ESSOR programme is undoubtedly an excellent candidate for the EDIDP, thus if funded by this EC initiative it would receive an additional 10% bonus.
But there are other PESCO projects, the Maritime Semiautonomous Systems for Mine Countermeasures Belgian-Netherlands initiative, or the family of armoured vehicles led by Italy, that may come to OCCAR in the future if they develop further and the nations so wish. OCCAR stands ready to take the challenge.

The TIGER helicopter programme is one of the complex capability-building programmes managed by OCCAR.

ESD: The TIGER helicopter fleet is to become subject to a midlife upgrade. What is to be accomplished? What is the task of OCCAR in the scope of this programme?
Alfonso-Meiriño: The TIGER Helicopter Programme is one of the complex capability-building programmes managed by OCCAR, currently going through a transition phase. This programme has been managed since 2001, although it started as a Franco- German development in September 1998. This system, already operational in the armies of Germany, France, Spain and Australia, is available in four different variants. Germany has contracted 68 UHT helicopters of the 163 ordered by the three European nations, with 67 already delivered, and the last one expected during the month of July, and with it, the end of the UHT production. The UHT variant can be deployed for armed reconnaissance, anti-tank missions, anti-helicopter tasks and escort/combat support missions, depending on the choice of weapons. The TIGER programme is entering into the preparation phase of its Mid-Life Upgrade with the aim to get the first entry into service of the Mark III helicopter in 2025 for France and 2026 for Germany. The three nations are currently harmonising their requirements with the view to place the Mark III development contract in 2020. OCCAR would be entrusted by the Programme PS to manage the Mark III programme.

The upgrade has the double objective of tackling the obsolescence and the modification of its systems, including armaments, and thus requires an important technological development.

ESD: After Germany, The Netherlands and Lithuania, Slovenia and Australia have selected the BOXER vehicle. The UK is considering rejoining the programme in light of the country's MIV requirement. What effect does this have on OCCAR's work?
Alfonso-Meiriño: As I mentioned earlier, the Convention has a clear European vocation, and the BOXER programme is an obvious example, as it comprises a Member State, Germany and two non-MS, the Netherlands and Lithuania, that will shortly be joined by Slovenia and the UK (currently in integration).
Australia has decided to procure the BOXER vehicle but directly through industry, so for the moment they do not intend to join OCCAR.
The Convention allows for this model, where MS work with non-MS in a programme, but OCCAR is so flexible that even a programme with participation of non-MS would find a place in the Organisation.
The fact that Slovenia and the UK are in the process of integration means of course that some activities need to be undertaken, such as the conclusion of a MoU, Programme Decision and contract placement. In this particular case, as the PD already exists, it is up to the Division to proceed with these integration activities; which can require that the nation in integration provides Detached National Experts (DNE) to cope with the extra work. This is the case with the UK, which has already sent several DNEs to work with the PD in Bonn.
The integration process also requires the involvement of the OCCAR CO, and thus the integration of any new Programme Participating State or new phase or programme is subject to approval by OCCAR's Board of Supervisors. This is the highest decision-making body in OCCAR, and their decision, based on my assessment of the resources needed for the completion of the integration, is meant to avoid other areas suffering from the new processes to be undertaken, as this would result in damage to our reputation.

ESD: What are the current participants in the European MALE RPAS programme? What are the next steps?
Alfonso-Meiriño: The MALE RPAS has four PS; Germany, Spain, France and Italy. Belgium follows this programme with great interest from its observer status that was obtained in 2017.
The programme is currently in the final steps of its stage 1 for the definition phase that started in 2015. The PS have already decided to go ahead with a second stage of a global nature, which will involve a contract for the development, production and initial in-service support in the course of 2019 of a RPAS. MALE RPAS is expected to have a takeoff weight of approximately 11 tonnes, will be powered by two turbo-prop engines and is scheduled to enter into service in 2025.
The industrial set-up is currently under negotiation and counts with Airbus Defence and Space GmbH at the level of main contractor, and with Leonardo, Dassault Aviation and Airbus Defence and Space S.A.U. as major subcontractors, but will undoubtedly bring on board a broad spectrum of European SMEs for future phases, given the EU initiatives requirements.
Taking into account the developmental nature of this programme and that the industrial set-up complies with the EU EDIDP requirements, I believe this programme is a firm candidate to receive EU funding as well.


The MALE RPAS programme is a candidate for EU funding.

ESD: Based on last year's political directives, the bilateral armaments cooperation of France and Germany seems to be getting momentum? What support can OCCAR render in the scope of these efforts?
Alfonso-Meiriño: Indeed the meeting of the French and German Ministers of Defence on 19 June with the signature of the two Letters of Intent for the collaboration in the Future Combat Air System and the Main Ground Combat System has meant a step forward. France and Germany have a long history of cooperation, they are both pushing for the European strategic autonomy requested by the High Representative Federica Mogherini in her Global Strategy, and these future programmes are a means to achieve it, in supporting the EDTIB.
OCCAR's role in support of these efforts will very much depend on the will of these nations.
Then again, OCCAR's core business is the management of complex armaments programmes, which is the case in these two initiatives, and one of the missions assigned by the founding fathers was precisely to support the EDTIB. OCCAR is ready to take the challenge, if these two nations so wish.

ESD: The UK is planning to leave the EU (and thus the Common Defence and Security Policy) in 2019. Will Brexit have an effect on OCCAR?
Alfonso-Meiriño: As you know, the UK is one of the founding members of the Organisation and since OCCAR is not part of the European Union, BREXIT does not affect it, a priori.
OCCAR nations are studying the impact on the A400M programme, as it follows UK law. Also, the potential impact on the trade or the transfer of defence-related products is being evaluated, but it is our understanding that there will always be a trade agreement between the UK and the European Union to facilitate such transactions.
The participation of the UK in programmes managed by OCCAR, funded by the EDIDP initiative, would also constitute no barrier, as I particularly do not believe that these fund incentives have sufficient weight to invalidate other reasons that would bring any nation to a bilateral/multilateral cooperation with the UK.

ESD: What are the advantages resulting from the cooperation with other international organisations like EDA, NSPA, EATC?
Alfonso-Meiriño: OCCAR has a long-standing cooperation with the EDA,

with which an Administrative Arrangement (AA) was signed in 2012, and an interface document with the organisation was updated only last year. The EU Council of 2012 invited EDA to seek the greatest synergies with OCCAR, noting the close working relationship between the two organisations. EDA has a role in the identification and preparation of new cooperative opportunities between its participating MS, so they have an important role in the upstream part of the definition of a programme. Then, when a programme is mature, they may, using the existing mechanisms (AA, interface document), transition the programme to OCCAR. So we see each other as mutual reinforcing partners, with no duplication of efforts.

OCCAR has a long-standing collaboration also with NSPA. OCCAR is a customer of this NATO Agency for some diverse activities in the In-Service domain for some of its programmes. For instance, in the case of TIGER, a Service Level Agreement was concluded for the invoicing through an IT system, called NAMSIS, whereas for BOXER the Service Level Agreement was signed only last year for the ammunition of the Lithuanian variant.

On the other hand, NSPA is an OCCAR customer for the MMF Programme, and OCCAR procures the aircraft, currently 8 but with a potential to become 11, should more nations decide to join.

I believe the cooperation between the two organisations is a great example of the relationship and complementary efficiency in the domain of acquiring and supporting the military capabilities needed for the European nations.

And last but not least, our cooperation with EATC focuses on the A400M and aims to achieve an efficient European air transport and increased European airlift capability. Within the European air transport domain, there are common activities relating to the A400M capability within the remit of EATC. We actually meet at least once a year, also with EDA, because we consider that increased cooperation between the three entities can bring significant added value to their respective MS by exploiting synergies and maximising cost effectiveness, enabling the successful multinational operation of the aircraft is in the benefit of the respective MS.

ESD: Can you confirm that Germany has plans to join the ESSOR project and has accepted to pay a share of the development costs already invested?

Alfonso-Meiriño: The ESSOR PS indeed recognise the strategic importance of Germany joining the ESSOR Programme. On the other hand, Germany fully recognises the significant effort and investment provided by the ESSOR PS in order to achieve the results that are today on the table, as well as the new developments foreseen in the OC1 Phase, which represent the foundation to complete the development of the High Data Rate (HDR) waveform.

Germany is willing to participate in an active role in the future development of ESSOR and will benefit from the ESSOR outcomes and knowledge so far accumulated, therefore Germany's contribution to the programme will take into account the investments and risks sustained by the other ESSOR PS to achieve the successes of the programme to date.

The interview was conducted by Peter Bossdorf.

Aggregation – a Necessity?

European Naval Industry Initiatives

Giulia Tilenni

Relevant stakeholders are well aware of the need to pursue European shipyards' integration to tackle competition from abroad. However, a number of different political and industrial dynamics make this integration, while viable in theory, extremely complex to translate into practise.

In ESD 03/2018 we argued that European shipyards need to work on identifying and promptly implementing solutions to maintain the competitiveness of their industrial models in the global market. Aggregation/merging has been identified several times as a viable tool for maintaining European shipyards' leading position at the global level. Despite the difficulties in translating aggregation into practice, at least two pushing factors should convince European states to choose this solution.

First, aggregation could compensate for the new shape the naval defence market is taking. Despite being crucial for enhancing European shipyards' competitiveness in the naval market, significant investments in R&D are insufficient for maintaining a leading position at the global level. So far, foreign shipyards, especially Chinese, have been prioritising quantity over quality. However, this paradigm has now changed and the quality of their products has constantly improved. Mergers and acquisitions are generally seen as the most viable way of resolving the competitive battle between European shipyards, as they can increase cost efficiency. Secondly, aggregation could be used to better exploit the opportunities offered by the limited number of European naval programmes. Investment in navies is on the rise again after a decade of scarcity, as several countries have launched new programmes to modernise their navies or to procure new vessels.

Programmes such as the Italian Legge Navale for the development of the Pattugliatori Polivalenti d'Altura (multipurpose offshore patrol vessels), the programme for the future French aircraft carrier and the development of the future British frigates are excellent business opportunities for regional shipyards.

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Despite these driving factors, aggregation is taking place at an extremely slow pace in Europe. European shipyards do not seem interested in pursuing aggregation with their European counterparts in order to boost competitiveness. Rather, they prefer to work on strengthening partnerships between shipyards and national marine system providers in order to achieve a stronger position in deals. For example, the fact that the French company Thales holds 35% of the Naval Group makes the joint participation of the two companies in tenders a given. However, this special relationship made negotiations with Fincantieri on the acquisition of STX shipyards in France more difficult, as Fincantieri is working with the Italian company Leonardo. And, of course, Leonardo intends to continue its partnership with Fincantieri after the STX deal. The Dutch shipyard Damen also prefers Thales Netherlands as a partner for marine systems.

Negative Influences

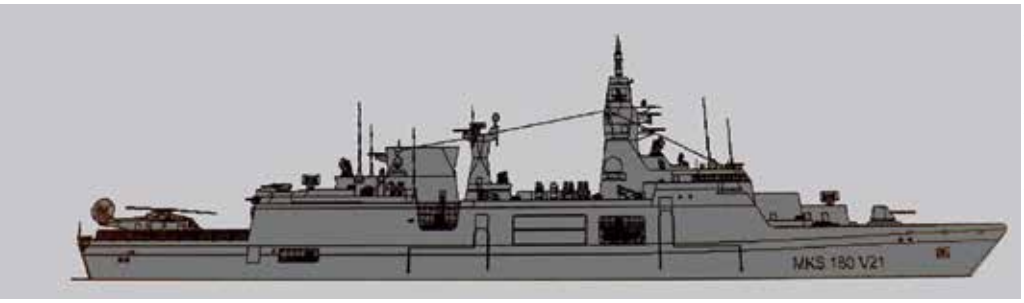
After years of limited investment in naval procurement, states such as Italy, the UK and France were forced to launch major procurement programmes to regain at least some maritime capabilities. In fact, their fleets were in such poor condition that modernisation was not enough to compensate for years of under-funding. Such programmes have a very important impact on European shipyards, both economically and industrially. In fact, the small number of procurement programmes and the lack of aggregation of shipyards at European level all have a detrimental effect on each other.

The lack of integration reduces competitiveness and this leads governments to favour foreign companies over national companies for the procurement of their ships. The German tender for the Multi-Role Combat Ship 180 (MKS 180) is an interesting example of such an argument.

Photo: SAAB

SAAB Kockums' A26 submarine, a long awaited project still unrealised

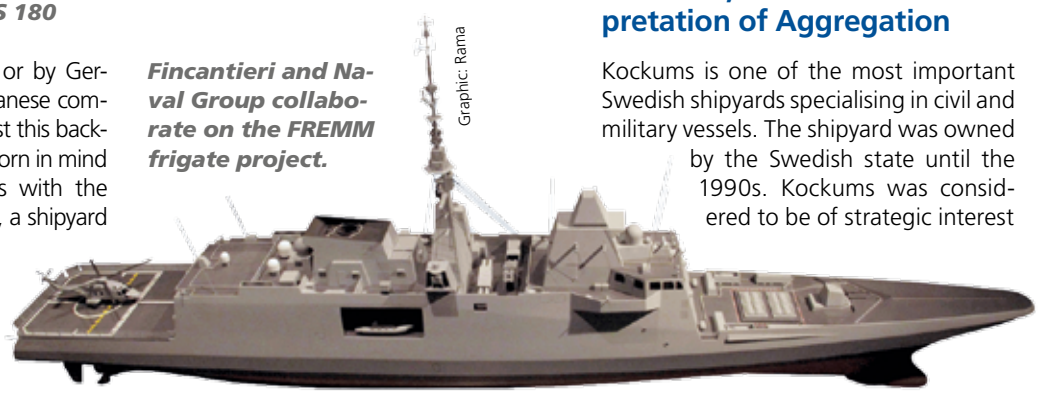
Last March the Federal Agency for Defense Technology (BAAINBw) excluded two national shipyards, ThyssenKrupp Marine System (TKMS) and its partner Lürssen, from the MKS 180 tender.
For example, the next German multi-role combat ship could be produced by Damen Shipyards (a foreign company) or by German Naval Yards (a French-Lebanese company based in Germany). Against this background, however, it should be born in mind that Damen Werft cooperates with the Hamburg shipyard Blohm+Voss, a shipyard of the Lürssen Group, and that TKMS announced in August a cooperation agreement as subcontractor to the German shipyards for the MKS 180 programme.



Graphic: Dr. Karl-Heinz Hochaus

Sample design of the MKS 180

Fincantieri and Naval Group collaborate on the FREMM frigate project.



Graphic: Rama

The few major procurement programmes in Europe force companies to adhere to uniform market logic in order to ensure production and participate in tenders abroad. The result is that European shipyards, which should aim for aggregation in order to maintain their competitiveness, are actually becoming competitors inside and outside Europe. The international sale of the European multipurpose frigate FREMM is an example of this negative dynamic. Fincantieri (Italy) and DCNS/Naval Group (France) have been working together since 2000 on the FREMM project, developed in collaboration with OCCAR (Organisation for Joint Armament Cooperation). However, the two countries decided to participate jointly in calls for tenders and not to offer a mixture of French and Italian FREMMs (depending on the adaptation of each country) until 2017. Although France sold its FREMMs to countries such as Algeria and Egypt, the joint tender with Fincantieri proved unsuccessful as Canada rejected the proposal and the two countries withdrew from the MKS 180 bid.
In summary, lack of aggregation adversely affects competitiveness and European countries may be forced to procure abroad rather than favour their national yards. In this way, the opportunities for European shipyards are further reduced. As a result, these yards find it difficult to consolidate their position on the European market and are forced to compete abroad. Due to the limited number of large procurement programmes, any lost tender is an existential threat to the survival of Europe's shipyards.

Threats to European Shipyards

In an ideal European industrial model, aggregated yards should benefit from aggregation itself. At the same time, each yard should make the same level of sacrifice in terms of jobs, production and management so that aggregation can take place at the European level. But the overall picture of European yards suggests that in reality each yard is looking to maximise its profits and strengthen its own position on the market, even if this means fierce competition with other European shipyards.
Conversely, European yards tend to reject all sacrifices, which has a doubly negative impact. For one thing, this attitude blocks any possibility of putting aggregation into practise and thus limits the possibility of maximising scarce business opportunities in Europe. The second is that this uncooperative behaviour impedes the emergence of new windows of opportunity, as it impairs the competitiveness of the shipyards and potential bidders have less confidence in the quality of their projects.
The more European yards postpone their aggregation, the more foreign competitors - mainly from Asia - undermine their business opportunities. As analysed in issue 3/2018, Asian shipyards are gaining importance in the naval market. The increase in military expenditure in this sector and the growing demand for larger and more complex vessels have helped to improve the quality of Asian shipyards. These yards can now be regarded as direct competitors to Europe in terms of technical capabilities, but their national industrial dynamism (e.g. in terms of employment policy) makes them much more competitive than European yards. As large industrial programmes are already underway in Europe, companies may already have lost some important business opportunities.

Kockums, or the Misinterpretation of Aggregation

Kockums is one of the most important Swedish shipyards specialising in civil and military vessels. The shipyard was owned by the Swedish state until the 1990s. Kockums was considered to be of strategic interest to Sweden as it had experience in building submarines. In the 1990s, Kockums tried to persuade its unique customer, the Swedish Defence Material Administration (FMV), to cooperate on the A26 submarine, a long-awaited project that had not yet been completed. However, the customer seemed not to be interested in the development of this programme. For this reason, TKMS showed interest in both the yard and the A26 programme and made an offer to purchase the yard.
From Kockums' point of view, this aggregation could have served as a catalyst for the final development of the A26 submarines. However, TKMS expressed concerns about the project, which was abandoned again. In fact, the development of A26 was not one of the reasons why TKMS merged with Kockums. According to some sources, the real motivation behind this merger was the possibility of eliminating a competitor, which is a perfectly legitimate business strategy. TKMS continued to participate solely in tenders, particularly outside Europe, and did not fully exploit Kockums' technical capabilities, as the Swedish shipyard was mainly involved in logistics and other tasks. Thus being unable to apply its strong capabilities acquired working on submarines. As

Kockums' capabilities remained unused, the shipyard risked loosing key technical capabilities and know how. As the Cold War was over and tension with Russia had diminished, the Swedish government was no longer concerned and did not take measures to implement the A26 programme. However, the Russian invasion of the Crimea marked a turning point for Sweden's defence strategy; Kockums and their expertise in the field of submarines regained strategic importance for the country. In 2014, SAAB acquired the yard at the request of the Swedish government, which was prepared to "renationalise" Kockums, probably in exchange for the procurement of A26 submarines.

Photo: Rama

Damen Shipyards in Schiedam, The Netherlands

Potential Driving Factors for Aggregation

As already analysed, attempts at aggregation cannot be sector-specific. Pursuing market dynamics means concentrating on competition in order to ensure the viability of companies. Companies are forced to maintain their position in the market and to win tenders through competition. In order to maximise their chances of winning tenders, companies are likely to continue to favour cooperation with other European companies on a case-by-case basis, the advantage being that companies can identify their partners according to the operational requirements to which each tender should respond. However, it is clear that such cooperation is not permanent; since this strategy is based on sector-specific considerations, it is strongly influenced by contingencies - for example in relation to defence budgets and the volume of procurement programmes.

In addition, if a form of integration is sought, it will be supported by economic/strategic considerations on the part of the individual companies, so that it will not benefit the entire defence shipyard sector, although this should be the desired result of the aggregation. Fincantieri recently announced that if the rumour about the sale of TKMS' sub-

marine business is confirmed, it will examine the possibility of participating in the tender to "consolidate the company's position on the European market", as CEO Giuseppe Bono explained. The two companies, which have already worked together in a special joint venture for the production of Italian U-212A submarines, are also considering the possibility of jointly developing a submarine. According to Bono, such an agreement "will not be contrary to the agreement discussed with Naval Group". France and Italy are currently examining the steering committee's proposals for the agreement between Naval Group and Fincantieri on the former STX shipyard, which has (again) been renamed Chantiers de l'Atlantique and which will be published later this year. Should Fincantieri finalise the purchase of TKMS, the case will be similar to that of Kockums.

What factors could encourage companies to favour aggregation, even if it is not the most economically or industrially advantageous solution? In the case of European shipyards, EU funds are ineffective because of their high technological cost. As companies seek diversification in their fight to maintain competitiveness, it will be difficult to identify subsectors that could benefit from EU funds, such as those evaluated for inclusion in the 2021-2027 multiannual financial framework. In Indeed, no proposal for EU funding took European shipyards into account.

As with other European defence sectors, changes in strategic planning are the only driving force for aggregation. In particular, strategic planning should be accompanied by some kind of common European force, so that companies pursue aggregation rather than cooperation, and both should be integrated as far as possible. Such a model could completely reverse the existing economic model as it could change the dynamics of the defence yards to which they respond in their operations. For example, although aggregated strategic planning focuses on increasing efficiency, it could result in the multiplication of programmes, thereby reducing the need for companies to compete to maintain their market position.

Final Remarks

However, there are still some obstacles to aggregation. Firstly, as is customary in the European defence market, the lack of political will seriously undermines the possibility of better cooperation. The creation of integrated strategic planning is the most important impetus for integration, but it can only happen if the European states adhere to common foreign and security policy guidelines and pursue common foreign and security objectives. At the same time, shipyards should be prepared to make sacrifices if they want to aggregate. To do so, they must change their attitude towards this issue. So far, they have seen aggregation as a tool to reduce the number of competitors and improve their position in the market. This was the case with Kockums and could also be the case with Fincantieri-TKMS. If European yards are ready to move towards real European integration in the future, they should start to think systemically and work to improve the position of the whole European naval shipyard sector, and no longer chase individual advantage.

To sum up, despite the fact that the merging of shipyards is vital in order to survive in the face of increasing international competition, companies and states will continue to strive to maintain the status quo. These decisions will be fruitful for individual shipyards in the short term, but will end fatally for the entire European naval sector over the long term. ■

Arming the Ukraine

Denys Kolesnyk

In 1991 the Ukrainian armed forces were the fourth largest army in Europe. Then they witnessed a dramatic decline which left Ukraine defenceless against the Russian invasion. About three years ago the Ukraine embarked on a turnaround.

Graphic: Ukrainian Armed Forces

After the collapse of the Soviet Union and the proclamation of the Ukraine's independence, the government in Kiev inherited one of the most powerful armies in continental Europe and the world's third largest arsenal of nuclear weapons.

Since then, Kiev has gradually reduced its armed forces to a level where the Ukraine was thought to have no combat-ready units. It then succeeded in rebuilding its armed forces to an acceptable level. Moreover, the Ukrainian state was deprived of its nuclear capabilities in the mid-1990s. Throughout its modern history, the Ukrainian army has always been underfunded, marked by an enormous level of corruption, mismanagement and a series of scandals. All this led to the Ukraine remaining undefended after the Russian military intervention in Crimea and the Donbass.

A Bit of History

In 1991 the territory of the Ukraine contained enormous former Soviet military capabilities: almost 800,000 soldiers, 6500 battle tanks, about 7,000 armoured infantry fighting vehicles, up to 1,500 aircraft, more than 350 naval vessels, 1272 intercontinental ballistic missiles (ICBMs) with atomic charges and almost 2,500 tactical nuclear weapons.

Inspired by the spirit of the times after the fall of the Berlin Wall, the Ukraine announced in its 1990 Declaration of Independence that it would become "a permanently neutral state, not involved in military blocs and adhering to the three nuclear free principles: not to store, produce or buy nuclear weapons". In 1996, Ukraine lost all its nuclear weapons after the 1994 Budapest Memorandum on Security Guarantees.

Between 1991 and 1999, the armed forces experienced two waves of manpower reductions, with only 310 000 soldiers and 90 000 civilians serving in the army at the end of the 20th century. During that period, the Ukrainian army lost 600 aircraft, almost 250 helicopters, approximately 2400 battle tanks and 2000 IFVs.

The lack of resources was a permanent issue; in 2005 the army had only US$1.1Bn at its disposal. Thus, the total number of armed forces at the end of this year was 245,000, both military and civilian.

According to the White Paper of the Ukrainian Armed Forces, published for the first time in 2005, the numbers of military equipment had decreased significantly. In particular, if in 2001 Ukraine had 3928 battle tanks, it had in 2005 only 3058. The number of aircraft also fell from 874 to 575, and the Black Sea fleet had only 15 battleships, compared with four years earlier when it had 43.

The new government, which came to power through the 2005 Orange Revolution, decided to bring Ukraine closer to NATO. The 2008 NATO Bucharest Summit recognised that Ukraine would one day become a member of NATO. However, the 2008-2009 global financial crises did not help the Ukrainian defence budget, as it was the first victim in a series of government austerity measures to cope with a 15% fall in GDP.

Viktor Yanukovych's inauguration in 2010 made it clear that Ukraine needed to review its attitude towards NATO. The new edition of the Military Doctrine and National Security Strategy was published in 2012, reaffirmed Ukraine's neutral stance and its renunciation of NATO candidacy.

Photo: Dylan Malyasov

A Ukrainian BTR-4

Author

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Photo: Denys Kolesnyk

The CORSAR anti-tank missile is a domestic Ukrainian product and has been developed by the Kiev-based Luch engineering office

By the end of 2013, the headcount had hit rock bottom and totalled around 165,500, including 120,900 soldiers. The breakdown of expenditure had remained unchanged since the 2000s: Around 82.1% of the defence budget went towards supporting the activities of the armed forces and only 10.2% towards developing and overhauling military equipment.

All previous developments in the army as well as the lack of visions within the Ukrainian government, to say the least, made the Ukraine defenceless during the annexation of the Crimea.

The Russo-Ukrainian Conflict

According to some sources, the Ukrainian army could not deploy more than 6,000 combat-ready troops during the annexation of the Crimea in February-March 2014 and the Russian intervention in the Donbass.

In 2015, the Ukrainian government launched genuine structural reforms and adopted a National Security Strategy (NSS), which provides for a comprehensive reform of the defence and security sector with the goal of achieving full compliance with NATO standards by 2020. In the updated version of the military doctrine, Russia was recognised as an opponent, among other things, while Defence Bulletin 2016 became the roadmap for security and defence sector reform.

At the beginning of 2014, Ukrainian troops lacked basic equipment such as modern helmets, Meals Ready to Eat (MRE), tactical medical equipment, night vision goggles, not to mention battle tanks, IFVs, etc. As early as 2017, all the fundamentals were improving, including the introduction of new modern NATO uniform medical standards.

During the active phase of the conflict, the Ukraine relied largely on its own forces and gradually retrieved Soviet military equipment from the depots. A significant number of T-64, T-72, T-80 tanks, numerous IFVs and even such a monstrous piece of Soviet artillery as 203 mm 2S7 PION were overhauled and put back into service with the armed forces.

At the end of 2017, personnel were estimated at 250,000 employees, including 204,000 soldiers and 46,000 civilians. The government of Ukraine has provided about US$2.8Bn, or 2.5% of GDP.

According to the 2017 White Paper, the Ukraine managed to modernise 64 aircraft and helicopters, build and acquire 4 artillery boats, 66 anti-tank systems, 151 tanks and IFVs, and 690 artillery weapons between 2014 and 2017.

Despite the fact that Ukraine's armed forces are actively reforming in a way the Ukraine has never seen before, the problem of aging military equipment remains unsolved.

Ukraine's Industry has Something to Offer

In the last 25 years, since independence, the Ukrainian defence industry has shrunk due to a lack of MoD funding. For example, three major procurement programmes, namely the development of the SAPSAN missile, the An-70 military transport aircraft and the construction of Corvettes all not initiated.

From 2015, however, the Ukrainian defence industry saw a slight revival. The state-owned UkrOboronProm corporation, which unites more than 100 companies, began supplying state defence equipment. Relatively new military equipment was purchased by the Ukrainian army or put into series production by the Ukrainian defence sector, namely BTR-3, BTR-4, STUHNA-P ATGM, a reconnaissance drone and the modernisation of Su-25 and Su-27 aircraft to NATO standards.

As links with the Russian defence industry were severed, the Ukraine began to look for other suppliers to replace components manufactured in Russia. Unfortunately, as early as 2015, several Western democracies refused to supply the Ukraine with the necessary parts, equipment and systems, making it difficult for the Ukrainian defence industry to properly and quickly overcome its dependence on Russian spare parts and components.

By 2017 this problem this problem was partially solved by hiring more than 550 Ukrainian companies to replace Russian components. This is reflected in projects such as the production of An-132D aircraft that do not contain Russian parts, and the modernisation of the C-300 air defence complexes or the new SPECTATOR and HORLYTSYA drones.

With regard to anti-tank missiles, Ukrainian industry can offer the CORSAR portable missile and the STUHNA-P anti-tank missile system, both developed by the Kiev-based Luch engineering office. In December 2017, a new high-precision surface-surface guided missile was successfully tested at the military test site in the Odessa region. A new 300mm guided missile known as the VILHA, will strengthen the Ukrainian Army's defensive capabilities.

US-Made JAVELINs for Ukraine

Starting in 2014, Kiev asked Washington to supply so-called lethal weapons. The Obama administration hesitated with this idea, although some non-lethal equipment was

Photo: Airbus

Ukraine has bought 55 Airbus helicopters.

Photo: Dylan Malyasov

Ukraine sold 49 OPLOT tanks to Thailand to generate money for defence sector reform.

supplied, including more than 200 HMMWV vehicles (both armoured and unarmoured), 14 AN/TPQ-49 counter mortar and AN/TPQ-36 FIREFINDER weapon detection systems, more than 2000 night vision goggles and other personal protection equipment.

However, the new US government changed its approach and considered the supply of JAVELIN ATGMs to the Ukraine. The decision was officially announced by the US Defence Security Cooperation Agency (DSCA) in early March 2018 and states that "the proposed sale [of JAVELINs] will contribute to the foreign policy and national security of the United States by enhancing the security of Ukraine".

In April 2018, the Ukraine received a first batch of JAVELINs with another batch delivered in May. In total, the military aid package worth US$47M consisted of 210 JAVELIN missiles and 37 JAVELIN command launch units, including 2 spares.

The Ukrainian defence enterprises are also working with their US partners and they are looking for new ones. For instance, in 2017, the state enterprise "Plant 410 Civil Aviation" signed a memorandum with Rockwell Collins to expand the repair and modernisation of aircraft and engines.

But one of the biggest and most recent developments was an agreement between Antonov and Boeing's Aviall to support the production of the newest aircraft programme, the AN-1X8. Under the agreement, Aviall will manage manage the supply supply chain for the Antonov production, including logistics and forward stocking concepts, helping to fulfil orders of this aircraft programme and further aftermarket support.

It should be noted that US military assistance is decreasing compared with previous years; only recently, the US has approved a new US$250M military assistance package for Ukraine for 2019, of which US$50M is to be provided for lethal weapons.

Increasing International Cooperation

Recently, Ukraine bought 55 helicopters from Airbus Helicopters SAS worth €551M. The deal was announced in March 2018 at a meeting between Ukraine's Interior Minister Arsen Avakov, and French Foreign Minister Jean-Yves Le Drian. The deal includes delivery of three different Airbus helicopter types - H145, H125 and H225. Delivery will be split into two lots; lot 1 will include 37 helicopters and lot 2 18 helicopters. However, the first four helicopters are expected to be delivered in 2018.

Even though the new helicopters will be used mainly for traffic control, ground support, SAR, observation, air patrol, control of large-scale public events and public order incidents, this contract could be a starting point for a bilateral Franco-Ukrainian defence cooperation.

Photo: Dylan Malyasov

Ukraine's armed forces have put a number of Soviet-era T-64 tanks back into service.

The PT-17 tank is another example, this time between Poland and Ukraine. In April 2017, the Charkiw Morozov Design Bureau and the Polish company Bumar started a joint cooperation on a far-reaching modernisation of the T-72 tanks, whereby the modernised version is called PT-17.

The Ukraine's contribution to this project was the 120 mm smooth-bore gun, the fire control system including the automatic loading mechanism, the new engine, the transmission and the dynamic protection system. Poland contributed the target and optical equipment, the warning system, the remote-controlled combat unit with a 12.7 mm machine gun and a 40 mm grenade launcher. This project was carried out in full compliance with NATO standards and could evolve into a standard modernisation of the Ukrainian T-72.

It should be noted that Ukraine and Poland signed a new framework agreement on enhanced bilateral cooperation in the field of defence as early as 2016.

In addition, the Ukrainian Army repeatedly purchased the BMP-1AK infantry fighting vehicle from the Polish company Wtorplast in 2018 and is expected to receive the 122 mm self-propelled 2S1 GVOZDIKA howitzers as well. The first batch of IFVs has already been handed over to the Ukrainian ground forces, while the number of BMP-1AK and 2S1 GVOZDIKA howitzers remains secret.

Turkey is an important partner in a number of bilateral projects with significant potential. Because the Ukraine lacks modern means of communication, the signing of a US$43.6M agreement with the Turkish Aselsan will definitely help the army of Ukraine.

The aerospace cooperation between the two states is another important field, with Ukraine's Antonov and Turkish Aerospace Industry (TAI) signing an agreement on developing the An-188 mediumtransport aircraft the Ukraine with a carrying capacity of up to 50 tonnes.

The only ammunition factory the Ukraine had was lost in the Donbass. The Ukrainian state has to build a new one, but limited progress has been made so far. Turkey could be considered as a possible partner for the construction of such an ammunition factory in Ukraine, as one day the ammunition stockpile will be empty and Ukrainian troops will need both small arms ammunition and artillery projectiles.

In addition, the Turkish companies Otokar and FNSS have good opportunities for the development of armoured personnel carriers (APCs) and IFVs. Moreover, the Ukraine gained important experience from the Donbass war regarding the BTR-3 and BTR-4 vehicles. The cooperation between Turkey and Ukraine might also involve the development of a joint IFV, at least to pool resources and get the best out of both national defence industries.

On 14 March 2017, the Prime Minister of Turkey Binali Yildirim and his Ukrainian counterpart Volodymyr Groysman signed a memorandum-of-understanding relating to tank engines.

Since the Turkish Altay programme encountered a number of delays with the engine being the most problematic part, Ankara is interested in procurement and development of the engines. For instance, the transmission system of the Ukrainian engine 5TDMI1 has already powered the Turkish 155mm self-propelled howitzer FIRTINA. On the other side of the Atlantic, Canada could become another possible partner for the joint production of military equipment. At least the first steps for Canadian arms supplies to the Ukraine were taken in December 2017. The Canadian government has given the green light for the sale of arms to the Ukraine by its national defence companies. However, contractors entering into an agreement with the Ukraine must apply for an export licence, which will be reviewed on a case-by-case basis. In addition, each of these sales must include an end-user and end-use assessment describing the exact operator of the weapons and how they will be used.

Who Will Pay for Ukraine's Equipment?

As already mentioned, Ukraine has never had enough resources to develop its armed forces. The situation has not changed significantly, and the Ukrainian army can only count on modernised Soviet equipment, with only a few new parts being purchased every year, both from the national defence industry and from abroad.

This tight financial situation and the security challenges facing Ukraine are forcing the government to look for options for the development of the army. Firstly, the Ukraine will continue to rely on US military assistance, especially for high-tech items that the national defence industry cannot produce. Secondly, the modest budget for the modernisation and procurement of new military equipment excludes the purchase of new fighter jets, but favours the modernisation and procurement of equipment produced through joint cooperation.

Third, in order to generate more money for the economy, the Ukraine must export. That is why the contract for the supply of 49 Oplot-T tanks to the Thai army was crucial for the Ukraine. In addition, both the Ukrainian economy and the defence industry need foreign investment and technology transfer. The Ukrainian defence industry could indeed benefit from increased cooperation with the USA and Turkey.

Fourthly, the Ukraine has lost almost its entire fleet in the Crimea; the Ukrainian navy currently operates only a few ships. However, the Ukraine does not need to be a maritime power in the foreseeable future, which is why Kiev has to develop a so-called "mosquito fleet". The Ukraine has the shipbuilding capacity for such projects. All that is missing is adequate financing.

And last but not least: The Ukraine must carry out the necessary reforms and improve its economic performance, since no other country will pay for the development of the Ukrainian defence industry and armed forces. ■

Hard Cases for Tough Times

Tim Guest

Rugged cases, for the shipping and transit of vital and often sensitive equipment, weapons and ammunition over tough terrain, are widely used by both military and civil agencies alike.

Getting sensitive devices and critical equipment across rugged terrain and ensuring it arrives at its destination in one piece and fully operational cannot be guaranteed if it makes the journey unprotected. Uphill, down dale, over rocks and water, everything from electronic devices, radios, optical equipment, search and rescue (SAR) devices, weapons and ammunition need to be protected en route to their point of application if a mission, military or otherwise, is to be successful. And whether such equipment is man-portable and carried by individuals, or transported by vehicle, boat or aircraft, there are numerous options from a wide variety of vendors available to encase and protect equipment in order to ensure its integrity and operability.

The following article looks at the need for rugged cases to carry tactical mission equipment, as well as some of the processes involved in their manufacture and some of the vendors and their products active in this sector.

Setting the Scene

The increasing use of, and reliance on, high-tech devices and electronics by military, special operations forces, security, SAR and other user groups has seen a growing need for protective and often bespoke, application-specific cases to protect equipment from the rigours of often perilous transport. While military cases through the ages have been constructed from a variety of metals and woods, today's cases draw on the latest injection-moulding processes using state-of-the-art polymer-based materials. Many vendors produce standard off-the-shelf systems that can be shipped quickly for more common applications. Airtight, waterproof, dustproof and corrosion resistance are typical in most portfolios and, depending on the application, internal moulding to provide a fitted, shaped interior for a specific device is usual. At the same time, bespoke solutions for specific users and uses are also offered by most. And while many OEMs provide a one-stop shop making both the case shell and the custom foam interiors, the latter is also the preserve of specialist companies working with the outer shell OEMs; companies like Weepack in France, which specialises in polypropylene 'mousse' interiors. According to commercial director Gilbert Juan, talking with ESD, Weepack often works with end customers who have procured OEM cases such as Peli and MAX cases, and 3D design polypropylene interiors for specific needs and user specs. In the defence and aerospace field, such customers have included the French Ministry of Defence, as well as leading vendors like Rolls Royce, Thales and UTC Aerospace.

And as well as foam interiors, cases used in many operational scenarios may require alternative interiors comprising rigid rack mount systems, instead, such as with cases used as mobile armouries to house several rifles.

Vendor Views

Lucio Sirotti, Export Director at the MAX cases' manufacturer, Plastica Panaro, told ESD that its cases, used by UN agencies and military organisations around the world, are produced with an injection moulding process, using a polypropylene-based compound that the company has developed. Plastica Panaro makes its own custom foam inlays and screen prints its cases, if required, with a customer logo or brand name. Max cases, IP67 certified and meeting Stanag 4280 and DEF STAN 81-41, go through rigorous testing including vibration testing to ensure they are dustproof, shock resistant, waterproof and can operate without losing their integrity in temperatures between +90 and -30°C. Key solutions include its MAX540 H245 TR with a telescopic handle and wheels, cubed foam and padded dividers internally; the MAX800GPB (convoluted foam interior), MAX800S (cubed foam interior) and MAX800SAD (high-density foam interior), all systems for a range of military uses. Another example for secu-

Photo: Peli-Hardigg

Rugged, militarised cases keep even the most sensitive electronics and comms equipment intact in the harshest environments.

Author

Tim Guest is a defence and aerospace journalist and former officer in the Royal Artillery.

rity/military use is the MAX620 H250 BL, which is tailored to carry pistols and magazines. Managing Director at CP Cases Peter Ross, told ESD that the manufacturing process in relation to the company's own cases uses modern high-performance materials, such as composites and multi-shot moulded products, which have "elevated the mechanical performance of the company's range of ruggedised cases and containers for military deployment". The users' choice of product type is usually dictated by the application. CP Pro flight cases were the first of their type in Europe, introduced in 1971, and still designed and manufactured today when the application demands, typically when large and/or heavy and delicate equipment is being handled by third parties. When essential equipment is used in war zones and the like, in latitudes that span the tropics to the poles, more sophisticated rugged enclosures are required. They still have to accommodate violent drop, shock, vibration and climate protection, but then also have to be lightweight, and small. Ross added that the company offers a "one stop shop" to its customers, delivering complete design and manufacturing services from start to finish. "We design and build all our interiors, with a fully functioning foam engineering shop, 3D modelling facilities and prototyping service." The company seals its products against ingress from extreme climatic conditions as a long-time, tried-and-tested service. It uses in-house rain and immersion test facilities and all its mail product lines have been through accredited third-party test and accreditation to both military and commercial test specifications, such as MIL-STD-810 (US specs) Def Std (British specs) IP and STANAG specs.

The company has four primary product lines for military applications, all dependent on customer requirement and field use demands. These are: the AMAZON range, the ERack lightweight 19" racks, suitable for EMC-screened applications, the AirShip ultra-lightweight rigged containers for man-pack carrying applications and finally climate-controlled 19" racks for rapid deployment scenarios where both heating and cooling systems are incorporated to protect sensitive electronics, communications and encryption equipment.

According to Ross, CP Cases maintains readily available stock for quick-ship requirements, and has been called upon many times to deliver in days, and sometimes only hours, when an urgent need arises. He said the AMAZON cases had been in use recently with the Italian civil emergency rescue services assisting in the Genoa viaduct motorway collapse. The 'rotationally-moulded' AMAZON range are among the company's most popular military-certified products and are in use all over the world with many military and security-related customers. Bespoke solutions include blast and bullet-proof cases for specific international security agencies.

Photo: Plastica Panaro

Drone station carried in a MAX case from Plastica Panaro

Vendors on the Case

Peli-Hardigg cases are some of the best-known solutions in widespread military use and like other manufacturers follow stringent development and production processes to meet exacting user requirements and military standards. What the company calls its Advanced Case Solutions combine materials science, packaging engineering, project management and manufacturing processes that deliver de facto industry standards such as its cushioning curve formula. Its single-lid containers have been adopted by many defence and security agencies worldwide to protect sensitive technologies deployed in the most demanding environments, from drones to communications and electronics equipment and devices, to personal small arms and weaponry of many kinds.

Photo: DroneCases

Tethered drone flying from its DroneCases military case

Photo: Peli-Hardigg

Cases from a range of vendors are used in a wide variety of operational applications in command posts, temporary field medical records stations and many more settings.

The company designs the internal make-up of its cases, from simple foam cushions to extremely complex metal structures for use in dramatically diverse shipment, storage and user conditions to ensure interior stabilisation for any equipment is total. From deck-mounted equipment to bezel-mounted electronics with integrated exhaust fans, as well as cases with multiple access points and interface portals.

Metal decks or cradles are used to secure heavy equipment, and elastomeric shock mounts isolate metal fixtures from the case shell. Shock-absorbing foam is designed and shaped specifically to custom fit any equipment or component, with a variety of densities and material compositions available depending on application and need. Peli Advanced Case Solutions cases are designed to operate in extreme temperatures, to withstand radical oscillation or direct impact, to remain water tight when immersed in water, and to maintain seal integrity when exposed to chemicals or fine dust particulates. When military and OEM customers need to certify a case will perform to such specific requirements, Peli's Advanced Case Centres in the UK, France and the US subject cases to a range of rigorous lab tests including drop, vibration, leak, heat and dust tests under precise control conditions.

Peli-Hardigg mobile military cases cover operational scenarios from mobile armouries, to mobile medical and other mission critical carrying needs. Its mobile armoury range, for example, offers over 40 kinds of cases to house various numbers of rifles (such as the M4 Carbine), pistols (such as the M11 and Beretta 9mm), from a single weapon up to six or more M4s, or 24 M9 Berettas and more. Combinations of personal small arms, sights and magazines are accommodated by the designs of rack mounts and moulded interiors. Cases are also offered for grenade launchers, such as the M19, sniper rifles, such as the M24 with scope, and machine guns such as the M240B together with a spare barrel and, in the case of the new M240G, its infantry modification kit.

Photo: Peli-Hardigg

Tactical mission equipment of all kinds can be safely transported, knowing it will remain intact over the toughest terrain and road journeys.

Peli's mobile medical cases are rotomoulded solutions and include in-field portable solutions that are watertight, airtight and impact resistant and many combinations and customisations of interiors can be made to meet varying mission requirements. Some of its MEDCHEST range have wheels for mobility and can be outfitted with custom drawer dividers or foam dividing units; they are used to carry and deploy a wide range of field medical instruments and critical supplies.

Italian specialist case maker HPRC produces a wide range of standard, off-the-shelf case designs, as well as custom fit cases for various end user groups for civil as well as security applications. Its custom inlays are made from polypropylene of different densities and its milling processes enables the production of single-piece inlays but with several different depths. Multilayer inlays are made for customers whose requirement is to carry many small or different pieces of equipment in the same case. All HPRC cases go through stringent testing to withstand drops, impacts, watertight integrity and are suited for use in temperatures between -40 and +80°C. Its HPRC3500 is a backpack case suited for applications such as drone/UAV carriage and can incorporate a cubed foam interior. It meets ATA300, IP67, STANAG 4280 and DS 81-41 approvals.

Maibach in Germany produces the MILTAINER-TSC (Transport and Storage Container) range, which is constructed of glass-fibre reinforced plastics meeting German military specification VG 95 613. While the range includes larger storage containers in its TSC, HD (heavy duty), MD (medium duty), LW (lightweight), and RM (rotomoulded) ranges, it also comprises smaller portable and wheeled cases for tactical applications in its IM (injection moulded) range that are shock resistant, have been drop tested to ATA300 and MIL-STD-810 standards, comply to IP67 waterproof requirements. The LW range includes stable portable systems for use as tactical containers for manual

transportation in the field, with parts such as fasteners and wheels recessed into the body of the case to enhance resilience in extreme environments.

Photo: Peli-Hardigg

Cases to transport personal small arms and weapons, as well as specialist sniper rifles and field armouries, are offered by several case makers.

Another Italian player active in this sector is GT Line, which produces its Explorer Cases range of waterproof/watertight cases that are made from copolymer propylene at three manufacturing plants which it says are "strategically based around the world" to support the needs of its international customer base, which includes humanitarian, security and offshore industry users. It produces a range of heavy duty gun cases as well as offering armoury configurations of its appropriate cases to suit a wide range of small arms. Its Explorer Case 15416, for example, it claims to be "the longest rifle case" available on the market, is suited to carrying a .50-cal sniper rifle. The company says that mechanical strength is one of the most important aspects of such a long case; protecting and maintaining a zero POA/POI during transportation, the case must keep its rigidity, although without compromising transportability, or becoming too heavy. This is where GT Line's construction process comes in, with the properties of the copolymer polypropylene offering extreme rigidity. The case balances the use of ribbing with the polymer compound to deliver its high specs. In the UK, Leafield Cases, delivers solutions to sectors with mission critical needs that are waterproof and dustproof to IP67 standards and certifications include to STANAG 4340, DEF-STAN 81-41 Level J, DEF-STAN 81-144, MIL-STD-810G and ATA300. Like some of the other players in this sector, Leafield uses rotational moulding to produce detailed and robust cases, including those in its AEGIS range that it says, due to the process, are more resilient and durable than aluminium or wooden cases. They have more consistent wall thickness than blow-moulded cases, are more economical to 'tool' than injection-moulded cases and, in this age of environmental concerns, are completely recyclable. Leafield says that the process allows cases and lids to be produced with twin walls for greater strength and rigidity, and fittings and features can be readily moulded into the case walls and incorporated in the overall design. The company has developed its own 'multi-part mould' approach that it says enables handles, tie-down points and other features to be incorporated into the products. From a customer perspective this means that bespoke specs can be designed into a case quickly to meet specific needs. DroneCases in Germany works with Leafield and its AEGIS range, as well as using plastic cases from SKB to support the growing use of drones in military and civil sectors.

Photo: Peli-Hardigg

Peli's AIR cases are available for a range of demanding security applications.

Not to Forget Good Old Wood

With all this talk of polypropylene and rotational moulding you'd be forgiven for thinking that other, traditional materials are a thing of the past for the supply of cases for defence applications. One company proving this assumption wrong is Luxembourg-based No-Nail Boxes, which produces over 300,000 collapsible plywood boxes per year with some 90% of those meeting specific customer requirements; many of those clients are military in nature. It supplies its products, including ammunition/munitions boxes, to the likes of the Belgian, Dutch, French and Netherlands Armies and other NATO organisations.

Final Thought

With the plethora of heavy duty, high-spec, rugged cases available for a wealth of vendors, there is no excuse for sensitive and critical equipment to arrive at its operational destination in anything but one piece. Defence and security users have a huge choice and given the processes available and on offer from most makers even the most exacting end-user needs can be accommodated into a case design to protect mission equipment of all kinds. ■

European SHORAD Systems

Doug Richardson

On the night of 6 January 2018, a swarm of 13 piston-engined drones attacked Russia's Hmeimim Air Base in Western Syria and a Russian naval facility in the nearby port of Tartus.

According to Russian statements issued following the attack, seven drones were shot down by missiles launched by Pantsir SHORAD (short-range air defence) systems, while the remaining six were defeated by electronic-warfare measures. The most recent significant incident to involve the use of SHORAD systems, it illustrates the tactical importance of these unglamorous but vital missile systems.

SHORAD systems protect high-value ground targets against attacks by aircraft, helicopters, and air-to-surface missiles. Most have a maximum range of around 10 km, but some recent developments have extended this to around 20 km or more, overlapping with the lower end of the range coverage of medium-range SAM systems.

Most are mounted on wheeled or tracked vehicles to have the mobility needed to provide defence coverage either for a temporary asset such as a refuelling or regrouping area, or for rapidly-moving friendly forces. Where fixed assets such as an airfield or command centre need permanent protection, a SHORAD system could be installed on a shelter or other form of redeployable cabin, but a mobile system is able to rapidly change location in order to avoid being attacked.

The first Western attempt to create a mobile SHORAD system was the General Dynamics MIM-46 MAULER programme, begun by the US in the late 1950s with the aim of developing a self-contained system mounted on a single-tracked chassis. The 54 kg missile would have used radar beam-riding guidance coupled with passive infrared (IR) terminal homing, but the programme was plagued by technical problems and inadequate funding and was cancelled in 1965.

In the US, MAULER was replaced by the Philco-Ford (later Loral) MIM-72 CHAPARRAL, which used a surface-launched version of the IR-guided SIDEWINDER air-to-air missile. CHAPARRAL remained in operational service from 1969 until the 1990s, but the US made no further attempts to develop a more effective SHORAD solution. As a result, this class of weapon became a European speciality, and has remained so until the present day.

Photo: Rosoboronexport

Recent combat experience in Syria may have enhanced the sales prospects of KBP's PANTSIR (SA-22 GREYHOUND) combined gun and missile system.

By the end of 1962, the UK had cancelled its planned PT.428 missile system, a radar-guided weapon broadly similar to MAULER. Since a practical SHORAD mission required a less complex engineering solution the one that had been planned for MAULER and PT.428, the obvious choices were either semiautomatic command-to-line-of sight (SACLOS) guidance or passive IR homing. Engineers at what was then British Aircraft Corporation concluded that a SACLOS missile coupled with an optical tracking system seemed to be a more practical and potentially low-cost solution. They started work on a programme originally known as Sightline, then as ET.316, before finally being designated as RAPIER.

The RAPIER used semi-active command to line-of-sight (SACLOS) guidance. As the operator tracked a target using an optical sight, a sensor would detect any deviation between the missile's flight path and the line-of-sight to the target, then send the radio commands needed to steer the missile back onto the line-of-sight.

The complete system was designed in a towed configuration, and consisted of a launcher armed with four missiles (two mounted on either side of a surveillance radar), a tripod-mounted optical tracker, and an optional MARCONI Blindfire radar. Its designers were sufficiently confident in the potential accuracy of the system that they decided to use a missile whose 0.5 kg semi-armour-piercing warhead had no proximity fuze, but relied on a contact fuze. Following the Falklands War in 1982, RAPIER was initially credited with having downed 14 Argentinean aircraft, and achieving a further six "probables", but later analyses suggested that a more realistic figure was around four "kills".

Author

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

Photo: Rosoboronexport

JERNAS is the export version of MBDA's RAPIER Field Standard C.

In 1963 Nord Aviation of France and Bölkow of Germany began a study that resulted in the launch of the Roland programme as a joint development in 1964. The two companies later became Aérospatiale and MBB of Germany, and founded the Euromissile company that would become responsible for ROLAND, with Aerospatiale focussing on the ROLAND 1 day/clear-weather system and MBB tackling the ROLAND 2 all-weather system. Both used SACLOS guidance.

The French Army ordered a version based on the Giat Industries AMX-30R tracked chassis. A total of 83 ROLAND 1 and 98 ROLAND 2 systems were delivered. Deliveries of 140 systems to Germany began in June 1981. ROLAND 1 became operational in 1977, followed in 1984 by ROLAND 2. Export customers for the system were Argentina, Brazil, Iraq, Nigeria, Qatar, Spain, Slovenia, the US and Venezuela.

The US order proved controversial. Although Hughes was awarded a development contract in January 1975 for an American version of the ROLAND II, the resulting programme was repeatedly reduced in size. Issued to only a single Army National Guard battalion, the system was withdrawn from service in 1988.

Development of what would become the CROTALE system began in 1964 when South Africa awarded what was then Thomson-Houston a development contract for a mobile SHORAD system. Once again, SACLOS guidance was used. The resulting system used separate radar-equipped acquisition vehicles and firing vehicles. It entered service with the South African Armed Forces in 1971 under the designation CACTUS. In the same year, the French Air Force ordered one acquisition vehicle and two firing units for trials.

Most of the CROTALE systems produced for the French Armed Forces or for export were mounted on a P4R (4 × 4) wheeled vehicle, but a shelter-mounted variant was also produced to protect static targets. The system evolved through five variants – the original 1000 series, the 2000 series incorporating IFF and a TV camera, the 3000 series with automatic TV tracking), the 4000 series with a radio datalink that replaces the inter-vehicle cables used in earlier versions, and the 5000 series which added an optical tracker and an improved surveillance radar with a range of up to 18 km.

Versions designated SHAHINE were developed for Saudi Arabia. SHAHINE 1 was based on the CROTALE 1000 series and used the AMX-30 tank chassis, while the follow-on SHAHINE 2 was based on the 4000 series and delivered in versions based on the AMX-30 chassis or a towed shelter.

By the 1980s, RAPIER, ROLAND, and CROTALE were showing their age, so all three received an injection of new technology. The end results were the RAPIER Field Standards B2 and C, CROTALE NG, and ROLAND 3.

In 1985, development started on a new RAPIER tracker fitted with an IR thermal imaging system in place of the original optics. The launchers were upgraded to carry six missiles, while a Tactical Control Console allowed four RAPIER launchers to be controlled from a central location. This version was designated RAPIER DARKFIRE, and was deployed by the UK forces as Field Standard B2.

The new fire unit developed for RAPIER Field Standard 3 is armed with eight missiles, with four being mounted on either side of the new electro-optical (EO) tracking system, while a separate 3-D Dagger radar was used for surveillance. Full-scale production of Field Standard 3 began in 1993, and the system entered service three years later.

The only customer for Jernas export version was Malaysia, which ordered the system in 2002, and declared it operational in 2006.

The 1990s also saw the introduction of a new Mk2 variant of the RAPIER missile. This has a maximum range of 8 km, and is fitted with an IR proximity fuze.

Thales Defence Systems' CROTALE NG is based on the VT-1 missile. This has a maximum speed of Mach 3.5, and a range of about 11 km. CROTALE NG entered production in 1990, and is currently in service with the French Air Force, and has been exported to Finland, Georgia, and Greece.

Firing trials of a new CROTALE NG variant known as CROTALE Mk3 started in 2007, and the new variant has demonstrated a range of more than 15 km. It can operate in a stand-alone mode or in conjunction with other Mk 3 systems.

Introduced in 1989, the ROLAND 3 missile has a more effective warhead, an improved proximity fuze, and a maximum range of 8 km. In 1998 France and Germany embarked on a VMV upgrade programme intended to allow their ROLAND systems to remain in service until 2015/20. This involved replacing the existing optical sight with a GLAIVE electro-optical integrated IR sight assembly whose 8-12 micron band thermal imager, eye-safe laser range-finder, and IR localiser would give the system a third operating mode. It also simplified the man/machine interfaces by installing a microprocessor-based BKS system consisting of the LS control and guidance computer, KS co-ordination computer, and the BK commander's operations and fire unit control panel.

Upgraded French ROLAND systems will be able to fire the VT-1 missile, but Germany did not require this capability. Although devel-

Photo: MBDA

A modernisation programme has maintained the effectiveness of MBDA's ROLAND system.

opment of an improved missile designated RM5 was funded by France and Germany, it failed to attract orders and was shelved in 1991. Development of a further-improved ROLAND system designated M3S was begun in 1996. This adds new surveillance and tracking radars to the VMV configuration, but has yet to attract a customer.

In 2001, MBDA made the first vertical ground launches of MICA air-to-air missiles. These and subsequent tests confirmed the viability of MICA as a SHORAD system, and in 2005 France announced its first order for what became designated VL MICA. The system is made up of a Tactical Operations Centre (TOC) and between three and six multi-round launchers for MICA missiles fitted with either IR or Radio Frequency (RF) seekers. It can provide 360 degree coverage against aircraft, helicopters and air-to-ground missile threats. Once launched, the missiles fly under inertial guidance, then transition to the seeker for the homing stage of flight.

MBDA and Diehl BGT Defence are developing the LFK NG short-range missile which is intended to replace the FIM-92 STINGER MANPAD missiles that currently equip Germany's WIEZEL 2 OZELOT short-range air-defence vehicles. Due to be fielded under Germany´s Flugabwehr (SysFla) SysFla air-defence project, the LFK NG is a 28 kg missile with IR-homing guidance, and a maximum range of 8 km.

By the late 1990s, the UK faced the problem that RAPIER (and the Royal Navy's SEAWOLF short-range SAM systems would need to be replaced. Realising that a single type of missile could meet both requirements, MBDA began work on the Common Anti-air Modular Missile (CAMM), a 99 kg vertically-launched missile suitable for land and naval use.

Once launched out of its canister by a cold-gas system that will produce a minimal launch signature, the missile will fly a turnover manoeuvre towards the threat, ignite its rocket motor, then fly towards its target. Initially it will use inertial guidance updated by a dual-band two-way datalink, switching to a Ku-band active-radar seeker for terminal homing.

The CAMM missile first entered service as part of the SEA CEPTOR naval SAM system aboard the Royal Navy's Type 23 class frigate ARGYLL, which made its first firings last year. Development efforts are now focussed on the land-based variant. A truck-mounted launcher able to carry 12 missiles was used for early test firings, and a similar scheme was adopted for the Rheinmetall MAN Military Vehicles HX77 8x8 launcher vehicle which is now being delivered to the British Army as part of the SKY SABRE air defence system. Other components of the system are a truck-mounted Saab GIRAFFE Agile Multi-Beam (AMB) medium-range 3D radar, and a Rafael Advanced Defence Systems Modular, Integrated C4I Air & Missile Defence System (MIC4AD) fire-control centre.

Photo: MBDA

MBDA displayed the land-based version of its CAMM missile at the DSEI 2017 exhibition in London.

Photo: MBDA

The use of a vertical-launch technique has given MBDA's MICA air-to-air missile an additional SHORAD role. Fighter aircraft and surface-to-air launchers can draw on a common stock of RF – or IR-guided missiles.

Russia's first SHORAD systems were IR guided weapons similar in concept to the US CHAPARRAL. Although the 9K31 STRELA-1 (SA-9 GASKIN) and 9K35 STRELA-10 (SA-13 GOPHER) were deployed in large numbers, Russia's equivalent to RAPIER, ROLAND and CROTALE was the radar-guided Almaz-Antey 9K33 OSA (SA-8 GECKO). Test firings began in 1965, and showed the need for an extensive redesign of the missile and launch vehicle. Series production of the resulting OSA-M began in 1971, allowing the system to enter service in the following year. The OSA system was mounted on a wheeled vehicle fitted with an H-band surveillance radar, a J-band target-tracking radar, an 9Sh33 electro-optical tracker, and four ready-to-fire 9M33-series missiles. These are steered by a command-guidance system.

The system sold well on the export market, entering service with around 25 countries, and production ended in 1998. Although at least five users have retired the system, the numbers remaining in service have made the OSA an attractive candidate for

modernisation schemes that replace much of the existing electronic subsystems with modern equivalents. These include the Tetraedr 9K33M3-1T OSA-1T, and the Polish OSA-AKM-P1 Zadlo.

First fielded in 1986, the Almaz-Antey TOR (SA-15 GAUNTLET) is based on a tracked chassis whose turret carries a target-acquisition radar, a tracking radar, and eight vertically-launched missiles. The first version to enter service was the 9K330. This was based on the GM-355 chassis manufactured by MMZ. This was followed by the 9K331 TOR M1, which used the GM-5955 chassis and had a second guidance channel, so could engage two targets simultaneously.

The next major upgrade was the 9K332 TOR-M2E. Offered on an either wheeled or tracked chassis or in towed form, it has an improved fire control radar coverage, and four guidance channels, allowing up to four targets to be engaged simultaneously. It can be armed either with eight 9M331 missiles or 16 of the newer 9M338 missiles.

HISAR-A is the short-range component of Turkey's planned tactical SAM system. Like the longer-ranged HISAR-O, it uses a single-stage missile powered by a dual-pulse solid-propellant rocket motor guided initially by datalink, switching to an imaging infrared (IIR) seeker for terminal homing. Both missiles have a high degree of commonality, and use the same seeker, control system, high-explosive fragmentation warhead, and impact and proximity fuzes. Development of the radar, command & control, and fire control systems for both programmes is by Aselsan, while Roketsan is responsible for the missiles.

Two types of self-propelled launch system are planned; one based on an armoured vehicle, and the other on a wheeled chassis. Both will be armed with vertically-launched missiles. The tracked system will include a fire-control system incorporating a 3D phased-array search and track radar, and an electro-optical system incorporating thermal and daylight TV cameras, but the wheeled version will have no sensors but will be linked to a command control system via a mast-mounted datalink.

Russia's KBP 2K22/9M311 TUNGUSKA (SA-19 GRISON) combines gun and missile armament. Intended to defend motorised and armour formations, it consists of a GM-352 tracked chassis fitted with an E-band search radar, a J-band tracking radar, eight Fakel-designed KBM-built 9M311 missiles, and two 30 mm liquid-cooled 2A38M twin-barrel cannons. The guns can be fired on the move, but the vehicle has to halt in order to fire its missiles.

This tactical limitation was removed in the follow-on system. KBP's 96K6 PANTSIR-S1 (SA-22 GREYHOUND) retains the two 2A38 30 mm guns of the TUNGUSKA (with a reduced ammunition load), but can fire guns or missiles while moving. The system entered service armed with 12 command-guided 9M335 missiles (also referred to as the 57E6). These are similar to the 9M311 missiles used on TUNGUSKA, but have a longer tandem boost motor and a larger-diameter second stage. These changes extend the range to 12 km, or 18-20 km in the case of the 57E6E export version.

Initial TV reports of the Russian deployment of PANTSIR to Syria showed the standard version, but later footage showed the much-improved 72V6-E4 combat vehicle, which has a surveillance radar based on two phased-array antennas mounted back-to-back. The original radar could conduct only a single engagement, leaving the system's electro-optic sensor unit to handle a second. The new radar operates at a frequency of about 40 GHz, and can guide missiles against three targets simultaneously, while the EO subsystem handles a fourth engagement. The designation PANTSIR-S2 has been associated with a version that is reported to team six 57E6E missiles with two 30 mm cannons.

Planned developments of several SHORAD systems look to blur the boundaries between this class of weapon and medium-range SAM systems. The PANTSIR-SM variant currently entering service has a new missile with a maximum range of 40 km, while in March of this year, Russia's Interfax news agency reported that work was under way to develop a hypersonic missile for PANTSIR that would have a maximum range of 50-60 km.

MBDA has studied a longer-ranged version of its CAMM missile. Developed as a private venture, CAMM Extended Range (CAMM-ER) would use an elongated missile powered by a new rocket motor of extended length and increased diameter, and fitted with cruciform strakes intended to improve the missile's lift-to-drag coefficient. These changes would give the missile a maximum range of 45 km. The first customer for the new variant was Italy, which needs to replace its current ASPIDE/SPADA systems.

Despite the US DoD's traditional disinterest in the SHORAD mission, it seems that the concept is now being re-explored. In February 2017, the US Army sought sources for "Manoeuvre-SHORAD" solutions. But it is questionable whether this will prove a marketing opportunity for European systems. In the mid-1970s, the US ROLAND programme was touted as a demonstration that the US DoD was prepared to procure a major weapon system from Europe. In practice, it proved the opposite. ■

Photo: Aselsan

Turkey's HISAR-A will be deployed in the truck-mounted configuration shown here, or on a tracked chassis equipped with vertical launchers.

Photo: Rosoboronexport

Almaz-Antey's TOR (SA-15 GAUNTLET) vertically launched missile system has attracted orders from more than ten export customers.

Seafuture 2018 Exhibition

Luca Peruzzi

At the recent Seafuture exhibition and conference at La Spezia Naval Base, the Italian Navy and Italy's industry presented the latest developments in the maritime domain.

The sixth edition of Seafuture's maritime exhibition and conferences event, held from 19 to 23 June at the Italian Navy's La Spezia Naval Base, saw the participation of over 30 foreign navies' delegations and 180 companies and maritime governmental and non-governmental organisations mostly from Italy. Organised by the Italian Blue Growth (IBG) company, the Italian Industries Federation for Aerospace, Defence and Security (AIAD), the Region of Liguria and the La Spezia Chamber of Commerce and supported by the Italian Navy, Seafuture established itself as the international reference event in Italy regarding the maritime domain, combining industry, science, and technology. In presence of the new Undersecretary of Defence Raffaele Volpi and Italian Navy's Chief of Staff Admiral Valter Girardelli and visited by Italy's new Minister of Defence Elisabetta Trenta and ChoD General Claudio Graziano, a number of major national shipbuilding companies attended the conference, including Fincantieri, Orizzonte Sistemi Navali (OSN), Intermarine, Cantiere Navale Vittoria, Effebi, Ferretti Security and Defence (FSD), Baglietto Navy, Novamarine, Stem Marine, CABI Cattaneo, DRASS and Zodiac, along with combat system and naval equipment suppliers like Leonardo, MBDA, Elettronica, Calzoni, GEM Elettronica, Gay Marine, Civitanavi Systems, Ingegneria Dei Sistemi (IDS), Martec, RINA, Seastema, Sitep, Angelo Podestà, Insis, Elsel, Nuova Connavi, Tecnomar consortium, Eurocontrol, MTU, Volvo Penta, Thales Alenia Space Italia, as well as the French shipbuilder Naval Group and defence giant Thales, alongside NATO's Centre for Maritime Research and Experimentation (CMRE) and the Ligurian Cluster of Marine Technologies (DLTM).

In addition to seminars and workshops on topics ranging from defence and security to science and technology and maritime trade, and bilateral meetings with companies, the foreign delegations from around the world had the opportunity to visit Italy's latest generation of VIRGINIO FASAN ASW and LUIGI RIZZO ASuW configured FREMM frigates. Furthermore, experience could be gained with sea demonstrations on board the latest smaller ships and the older ships of the Italian Navy, which are eligible for modernisation by the national industry.

International Customers

At the industry forum "Facing global challenges through technological innovation towards Ship 4.0", the Fincantieri Group presented recent shipbuilding and life cycle management programmes. Additionally, the suppliers of combat systems and marine equipment (Leonardo, MBDA, Elettronica, L3 Calzoni etc.), the Italian Ministry of Defence's Directorate of Naval Weapons and the Navy itself presented the successful FREMM programme. Fincantieri (and its joint venture Orizzonte Sistemi Navali with Leonardo) is actively promoting the FREMM design in Australia (where the recent tender outcome favoured BAE Systems), the USA and Canada, and in the Middle East, where the Qatar Emiri Naval Forces (QENF) recently procured the 4,000 ton frigate and 3,000 ton multipurpose corvette designs in addition to the OPV and amphibious LPD ship. Fincantieri's successful design and the Italian Navy training package have also being offered to other international customers, such as Kuwait and Saudi Arabia. Fincantieri also proposed iterations of the Abu Dhabi Corvette design and presented a successful conversion project which turned older Italian MINERVA class corvettes into four modern OPVs for the Bangladesh Coast Guard. The project is an example of a possible retrofit of the combat ship with flight deck and combat and weapon systems.

On the closing day of the Seafuture, the launch of the Logistic Support Ship (LSS) built by Fincantieri took place at the nearby Muggiano shipyard. Together with the Multipurpose Patrol Ships (combat ships) or the Landing Helicopter Dock (LHD) and the two special ships built by Intermarine, the LSS will form the backbone of the future Italian Navy with FREEMs.

Intermarine continues to build MCMVs for foreign navies as the Italian Navy programme is long in coming. The Italian and QENF shipbuilding programmes were the focus of

Photo: Seafuture 2018

The opening ceremony of Seafuture 2018

Photos: Luca Peruzzi

The FSD 195 fast attack boat designed by Ferretti

the Leonardo presentations with almost all new generation combat and weapon systems for warfare above and under water. In addition to the latest developments of the ATHENA Command Management System (CMS), Leonardo presented KRONOS multi-function radar and the new SPS-732 family of naval air and ground surveillance radars, as well as the new 76mm single deck SOVRAPONTE gun. With a weight reduction of more than 30% compared to the standard gun and the integrated STRALES package of guided ammunition as well as the optional VULCANO long-range ammunition, the SOVRAPONTE is a lightweight defence system. The Oto Melara 40mm gun has also found an undisclosed customer. When it comes to missiles, MBDA presented the latest development of the TESEO Mk2A/OTOMAT Mk2 Block IV anti-ship missile to meet ITN requirements. The TESEO Mk2E's turbofan-equipped and airframe-optimised weapon system allegedly has twice the range of currently 180 km plus. MBDA also reported on the MARTE ER 100 km plus series ASM for multiplatform applications.

Electronic Wafare

The Elettronica Group presented the latest EW and Cyber developments with the new generation of ESM/CESM/RECM systems tested for the Italian Navy and already sold to QENF, as well as the RESM/CESM application for submarine platforms and the DIRCM mission against asymmetric naval threats and CY4GATE's cyber activities.

The Naval Weapons Directorate of the Italian MoD organised a series of industry workshops and revealed the latest developments in Italian maritime programmes, ranging from cost savings in the life cycle management of new ships by the Italian Navy Logistics Command together with OSN and the Swedish company Systecon to damage limitation with Martec and Dragonfly's 3D printing technology.

The latest experiments with Leonardo's VULCANO family of long-range guided weapons (to be completed by 2018) met with great interest, as did a presentation on their respective organisations and the benefits of programme management such as LSS and PPA programmes organised by the Italian MoD NAD and the European OCCAR Agency. Various companies, including Elettronica and C4YGATE, Leonardo and Selta, presented defence solutions for the maritime cyber-warfare sector, and Fincantieri unveiled its partnership with cyber specialist Haruspex.

In the underwater domain, the Italian MoD gave an insight into R&D programmes on a new national propulsion system for future U212 NFS (Near Future Submarine) platforms based on lithium traction batteries manufactured by Fincantieri, the leading national battery manufacturer FAAM and La Sapienza University, as well as the new generation AIP with Fincantieri. In June last year, the Italian Navy received the first standard BLACK SHARK Advanced Heavy Duty Torpedo (HWT) delivered by Leonardo for today's and tomorrow's U212A submarines. DRASS presented its family of Swimmer Delivery Vehicles (SDVs) - stealthy midgets and larger underwater combat platforms built for international customers. Starting with the 7.5-metre DG2 SDV (2 special operators), which can be deployed from the 35-metre and 169-tonne DG160 mini-submarine with two standard HWT engines but capable of transporting two additional HWTs externally as an alternative to the SDVs, the SDV family of DRASS 4 and 6 includes operable vehicles alongside smaller 85 and 120-tonne dwarfs and 350 and 450-tonne submarines. The Milan-based company C.A.B.I. Cattaneo, a well-known strategic partner of the Special Forces of the Italian Navy, presented the model of a new amphibious vehicle called DEEP SHADOW. Designed for export, the new SDV will be able to carry up to six combat swimmers with an optimised hull that allows high cruising speeds.

In a two-day closed-door workshop, the development and procurement of autonomous and remote-controlled submarines for the Italian Navy and the contribution of Italian industry and research were discussed. Led by the Italian Navy's Experimental Centre (CSSN, Centro di Sperimentazione e Supporto Navale) and Headquarters staff, the workshop was designed to highlight the latest technologies and Italian Navy requirements and to help industry monitor national and European R&D funding.

In regard to smaller surface platforms, Ferretti Group's Security and Defence division (FSD) was debuting in European waters with the fast attack craft variant of its FSD 195 20-metre fast patrol boat.

Launched in May for an undisclosed customer, the latest version features a

Photo: Luca Peruzzi

The 15-metre FFC-15 fast multipurpose transport landing vessel designed by Baglietto

Photo: Luca Peruzzi

Leonardo's AWHERO short-range UAS

lighter composite hull and superstructures capable to reach over 55 knots, with a 12.7mm/7.62mm weapon station on the bridge top, a dual-band Skytech/IDS SATCOM and SEAKEEPER NG9 gyro stabiliser, and capable to install two MBDA MARTE Mk2 anti-ship missile launchers and Rheinmetall's armouring kit. Baglietto's naval division unveiled the FFC-15 fast multi-purpose transport variant of the 15.8 metre MNI 15 aluminium bow hatch boat, which can reach 45 knots with water jets and can carry up to 18 troops in addition to a four-man crew. Stem Marine unveiled its 7.5 metre STEM 750 jet lifeboat, while Novamarine Defence presented its family of high-speed RHIBs sold worldwide for special tasks.

Unmanned Platforms

Seafuture 2018 also focused on unmanned surface and submerged platforms. Among other vehicles, the 12 metre long blue Sea Watch Dog (SWAD) unmanned/optionally steered surface vehicle (UPS/OPV), developed with government R&D funding by a DLTM-led consortium including Leonardo, Sitep, Elsel, Insis, Nuova Connavi and the University of Genoa, was unveiled. Based on an 11.9 metre RIHB with a capacity of 60 knots, the SWAD can be equipped with a 12.7mm remote-controlled weapon, an obstacle avoidance system and remote command and control for blue water operations. A Tuscan consortium of Effebi shipbuilders, Ingegneria Dei Sistemi (IDS) and Meccano Engineering unveiled the UPS as part of the sand project, which is also available for military purposes. When it comes to the airborne ship-launched domain, Leonardo's AWHERO short-range tactical rotor wing which was at the heart of the OCEAN 2020 demonstration programme, was supported by the IA-17, a small fixed wing UAS developed by IDS, which can be catapulted from a RIHB and which is currently tested by Italian special forces. ■

AERIUS Marine Wins Type 26 GCS Contract

(sb) AERIUS Marine of Hamburg, Germany, has been awarded a contract by BAE Systems to supply, design and integrate the HVAC (Heating, Ventilation and Air Conditioning)/CBRN (Chemical, Biological, Radioactive and Nuclear) protection systems for the new Royal Navy Type 26 Frigates.

The Type 26 represents the future backbone of the Royal Navy and will replace the ASW Type 23 frigates currently in service The Type 26 will provide increased capability through innovative design and is considered to be one the most advanced antisubmarine frigates in the world. The Type 26 will have a displacement of 6,900t, a length of 149.9m, and will host up to 208 personnel. The first of class, GLASGOW, is currently under construction at BAE Systems' facility on the Clyde. "We are very proud to have been awarded this important contract by BAE Systems," Said Klaus Aulich, COO of AERIUS Marine. "More than ten years ago we started our footprint in the UK, to develop the HVAC design for the QUEEN ELIZABETH-Class Aircraft Carriers. As a consequence of this, our activities have grown into a strong local UK organisation, which is the second largest within AERIUS Marine besides our German team. By winning the contract to supply these systems for the Type 26, the importance of our UK operations is being further substantiated."

AERIUS Marine is a market leader for the design, installation, component selection and delivery as well as commissioning of complex marine air conditioning solutions including NBC protection and is also active in the fields of refrigeration and fire fighting. The main focus of AERIUS Marine's activities is on new-builds of passenger, naval vessels, mega-yachts and the support of air conditioning systems during the entire life cycle of a ship. The company's roots lie in the Rud. Otto Meyer (ROM) company founded in 1858. AERIUS Marine is currently represented in Germany, the UK, France, India and Australia and has around 400 employees.

SPIKE LR2 for Australian BOXER

(ck) Australia has selected Rafael's SPIKE LR2 as the Anti-Tank Guided Weapon (ATGW) for the Australian Defence Force's (ADF) BOXER Combat Reconnaissance Vehicle (CRV). The SPIKE LR2 will be delivered by Varley Rafael Australia (VRA Systems), the joint venture between Rafael and the Varley Group. In addition to the SPIKE LR2, VRA Systems will deliver a range of Rafael products for the Australian market including the TROPHY Active Protection System (APS)

Photo: Rafael

for armoured vehicles; the TAMIR Counter-Rocket, Artillery & Missile (C-RAM) interceptor for short-range Ground Based Air Defence (GBAD); and the TORBUSTER Torpedo Counter-Measure (TCM) for submarines.

Support for Royal Navy Training Systems

(ck) The UK MoD has awarded Babcock International a five year Maritime Training Systems Through-Life Availability & Support Service (MARTASS) contract. A series of support packages, defined by the Maritime Combat System (MCS) and Maritime Training Acquisition Organisation (MTAO) teams within Defence Equipment and Support (DE&S), will be clustered into one contract for consolidated delivery by Babcock. Babcock will support training systems located across the Royal Navy and Defence establishments including Naval Bases and Air Stations. Through the contract, Babcock will deliver on-call engineering support, routine maintenance and the modernisation of legacy equipment to ensure the availability of the training equipment in the long-term. The contract will include provision of in-service support; spares and repairs; and technical refresh studies and insertions. MARTASS follows a 10 year Training Equipment Support Services (T-ESS) contract delivered by Babcock.

Egyptian-Built GOWIND Corvette Launched

(ck) On 6 September 2018 the first PORT-SAID GOWIND corvette was launched in Alexandria, Egypt. The PORT SAID corvette is the first warship ever built in Egypt. Together with the GOWIND corvette EL-FATEH, which is already in service with the Egyptian Navy, the new corvette is the fifth ship built by Naval Group for the Egyptian Navy. Naval Group has already delivered the FREMM frigate TAHYA MISR in 2015, the two Landing Helicopter Docks (LHD) NASSER and SADAT in 2016 and the GOWIND corvette EL-FATEH in 2017. Naval Group supports its customers by transferring technology at every stage of the construction process. Manufactured in Alexandria, the corvette is identical to the EL-FATEH built at Naval Group's Lorient site. The GOWIND corvette is a multi-mission combat ship for sovereign operations or protection of exclusive economic zones (EEZ). The GOWIND corvette integrates the latest generation of combat systems developed by the Naval Group and the associated technical equipment and sensors. In addition to Egypt, Malaysia purchased GOWIND corvettes in 2012.

Photo: Naval Group

MRO for TIGER Helicopter Engines

(ck) MTU and its partners Safran Helicopter Engines, Rolls-Royce and ITP Aero have approved AIA Bordeaux (Atelier Industriel de L'Aéronautique de Bordeaux) as the first MTR390-Enhanced MRO shop. In future the facility in France will maintain the MTR390 family of engines which power the TIGER combat helicopter, especially those operated by the French Armed Forces. The site can repair and overhaul all helicopters powered by MTR390-E engines. The AIA Bordeaux facility, as an approved shop for Line Replaceable Units (LRUs), overhauls LRUs on site for all participating nations. Approval of a further MTR390 MRO shop based in Spain is scheduled for April 2019. In both instances, MTU takes care of the project management. The MTR390 is a turboshaft engine featuring a free power turbine; it is the highest technology engine family in the 1,000-kW to 1,350-kW class. The MTR390 has accumulated over 200,000 flight hours.

Photo: MTU

Spectra SlingShot at DVD 2018

(sb) In collaboration with Jankel, Spectra Group (UK) Ltd, a leading provider of high-grade information security and communication capabilities, showcased their SlingShot communications system in a number of configurations, mounted in Jankel specialist military and civilian vehicles at DVD 2018 in the UK. SlingShot enables UHF and VHF ra-

Photo: Spectra

dios to work in the L-Band Satellite frequency, allowing users to instantly extend the range of their communications equipment to BLOS (Beyond Line of Sight). Conceived and designed to meet demanding Special Forces requirements, SlingShot also offers a significant number of benefits for conventional land forces requiring secure, reliable and robust Communications On The Move (COTM). In addition to voice, SlingShot enables low-latency data capability, supporting critical applications such as artillery fire missions, situational awareness and biometric analysis. With reduced cost compared with traditional TACSAT, increased channel availability, and almost no increase in the training requirement, SlingShot is a significant development in tactical communications. Spectra has strategic relationships with both Inmarsat, whose L-TAC™ service uses SlingShot, and Airbus, which brands SlingShot as TREx services. Over 3000 SlingShot systems are in operation world-wide, used by 18 different organisations, including several NATO countries, as Manpack, Vehicle, Maritime and Aviation fits. Simon Davies, CEO of Spectra Group said: "Spectra is delighted to be exhibiting SlingShot in collaboration with Jankel. This will allow us to highlight both the military and low-profile variants that will be of interest to any organisations or units that require BLOS COTM capability without drawing attention to their vehicles."

Innovative Control Centres

(ck) Innovative Business Software A/S and Saab Denmark will cooperate to deliver fully integrated CAD control room solutions for public safety. The cooperation focusses on the integration of the Innovative CAD platform, the Innovative Security ManagerTM and the Saab radio dispatch "TactiCall". The cooperation includes the design of the control centre and communications within the control centre. Alarm reception centres are increasingly demanding integrated communication across communication types, which makes it necessary to integrate conventional CAD and radio dispatch systems. "Operating separate systems at the alarm receiving centres is behind the times, and in combination with the integration of new communication technologies we can offer the customers a comprehensive CAD and communication solution, which manages all the alarm receiving centre's tasks – from receiving an alarm to task and resource management, continuous communication, fleet management and follow-up," explains Jens Larsen, VP Sales and Marketing at Innovative Business Software. Since the mid 1980s, Saab Denmark has developed integrated communications solutions for both the civil and defence sectors. TactiCall is currently operating on all continents and handles communications within police, coastal radio, navy, air force, and the energy sector.

Major Restructuring at Indra

(ck) In addition to a new brand and visual identity, Indra has completely changed the structure of its sales office to boost growth. Business and brand restructuring and commercial positioning have been transferred to both Indra's Transportation and Defense (T&D) industry and the IT industry. The new focus on end-to-end solutions, the development of value propositions and products aims to establish a specialized model for the company and its businesses. The rebranding is intended to support the new business strategy. Indra's IT subsidiary now operates under the brand name "Minsait - An Indra Company". Fernando Abril-Martorell, Chairman and CEO of Indra, says: "The new structure of our offer strengthens the transformation of Indra's business portfolio towards high-value technological solutions."


Photo: Indra

Schiebel Expands to Asia Pacific

(ck) Schiebel, a developer of Vertical Takeoff and Landing (VTOL) Unmanned Air Systems (UAS), has set up a subsidiary in Australia - Schiebel Pacific Pty Ltd (SPL) - to provide the Pacific region with a permanent and comprehensive programme, logistics and sales hub. Schiebel Group has already defence contracts in the region and sees further potential in Australia and in the region at large. Schiebel's Australian subsidiary is located in Shoalhaven, New South Wales, between Canberra and Sydney. With headquarters in Vienna (Austria), Schiebel now maintains production facilities in Wiener Neustadt (Austria) and Abu Dhabi (UAE), as well as offices in Washington DC (USA) and Phnom Penh (Cambodia).


Photo: Schiebel

New CEO at AERIUS Marine

(ck) AERIUS Marine GmbH, a supplier for air conditioning, refrigeration and fire extinguishing systems on ships, has appointed Dr. Tjerk de Vries as their new CEO. Together with Ulf Meyer (CFO) and Klaus Aulich (COO), de Vries forms the new management team. He has gained his shipbuilding experience within the classification society Germanischer Lloyd (GL). From 2010 to 2014, Dr. Tjerk de Vries was CTO and responsible for the classification business. In 2014, he managed the maritime merger between DNV and GL as integration director. In 2015, he became Regional Director for Western Europe and Africa. Mr. de Vries' task will be to reposition the company in a turbulent market and to expand the product portfolio.


Photo: AERIUS Marine

New Director at Milrem

(ck) Ugis Romanovs (42) has been appointed as Managing Director of Milrem SIA, a subsidiary of Patria, to develop defence sector services for the Latvian market as of September 2018. Romanovs has a solid experience in defence sector and has worked in the Latvian National Armed Forces in various positions for many years. Following his military career Romanovs has acted as a military adviser and consultant in the defence sector. He holds a Master's Degree in Military Leadership and Security and a Bachelor's Degree in Education at the Latvian National Defence Academy.


Photo: Milrem

Service for Mikoyan Helicopters

(ck) Many European countries still operate older Soviet-era Mikoyan helicopters. The Czech company LOM PRAHA s.p. is one of

Photo: LOM Praha

the few companies specialising in life-cycle support of Mi helicopters in NATO and EU countries - helicopters certified by Russian companies MVZ Mil and OAO Klimov, the Interstate Aviation Committee MAK and national aviation authorities. LOM Praha offers comprehensive overhaul and modernisation services for Mi-8/17/17/171/24/35 helicopters and full lifecycle support for their dynamic components TV3-117/VR-14/VR-24/APU. LOM Praha also offers pilot training (Mi-17/L-39) at its Flight Training Centre and tactical pilot training on simulators at its Tactical Simulation Centre. VR Group is a LOM Praha subsidiary, and as one of the world's leading simulation companies provides its full suite of flight simulation and pilot training technologies for all supported aircraft types.

New Director of Quality at WFEL

(ck) WFEL, a supplier of rapidly-deployable military bridging systems, appointed Dan Thompson to the new position of Quality Director. This new Director role has been formed in order to position the Quality function appropriately within the company structure. Thompson has held the position of WFEL's Quality Manager since 2016. In this new position, Dan will continue to oversee all activities needed to maintain WFEL's Quality Management, and will now include the expansion of scope of Approvals to reflect WFEL's potential new product portfolio. Thompson has held Quality and Engineering roles with Watson Steel and AMEC. He has a Master's Degree in Welding Engineering from Cranfield University.

Photo: WFEL

Success in Australia

(ck) Jankel, a manufacturer of specialised defence and security vehicles and protection systems, has exhibited its latest products at the Land Forces 2018 event in Adelaide, Australia. Jankel first entered the Australian market in 2003 with sales of Civilian Armoured Vehicles (CAVs) based on a Toyota chassis. Since then, Jankel has won contracts with the Australian MoD's Capability Acquisition and Sustainment Group (CASG) and, formerly, the Defence Materiel Organisation (DMO). In addition, Jankel is a supplier to a number of other contractors including Supacat and JCB. Jankel's Australian defence projects have included the provision of armour systems and up-armouring solutions for the PERENTIE, JCB 535-95, REDFIN 1A and REDFIN 1B SOV programmes. Jankel has also secured contracts in New Zealand, working directly with the MoD and its partners. Jankel has supported the Australian Industry Content (AIC) compliant programmes including the establishment of locally manufactured product lines. In total, Jankel's Australian business has generated over AUD$35M across a 15-year period.

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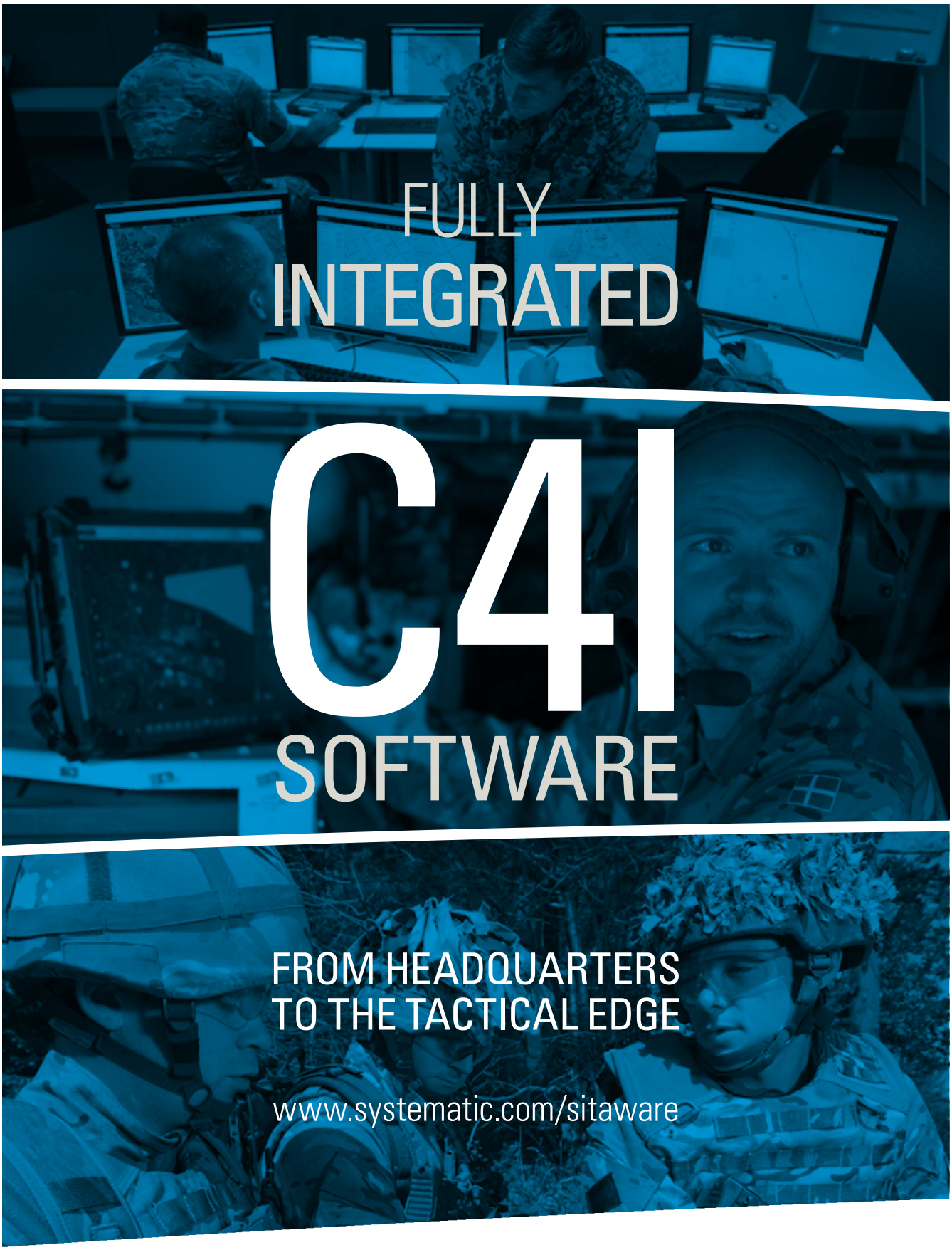

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