

European Security & Defence

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 **COUNTRY FOCUS:**
THE NETHERLANDS



Arming the Attack Helicopter

- The US and NATO
- Cyber Defence
- European Air Transport Command
- Croatian Air Force
- Active and Reactive Vehicle Protection
- Water Purification
- Digitisation of Land Forces
- Fleet Replenishment Ships
- Armasuisse
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70 Years of NATO



This spring NATO is looking back at 70 years of existence. Unlike comparable anniversaries in the past, however, this time no major festivities are being planned. The reason is not to be seen in the Alliance having lost any relevance or self-confidence; on the contrary, since the Wales Summit NATO has proved that it has not forgotten its original task, and that it is trying hard to cope with it. The road to the complete restoration of military capabilities required now may be long and rough, but it will be travelled, and the first signs of success are unmistakable. The festive mood at NATO is spoiled more by disputes which have overshadowed all summit conferences of late. At heart is a topic which for decades has been a recurring theme on the agenda. The USA may accept that it contributes by far the greater part of the defence capabilities of the Alliance. They owe this to their status as a global superpower and their claim to leadership. Their criticism, however, is that the Europeans, whose protection is, after all, the prime aim of NATO, are investing too little in their security, and do not hold to agreements to change this. In the past three decades, they have become accustomed to going along for a comfortable free ride, and diverting defence budgetary resources in favour of other budget items (predominantly welfare spending).

Donald Trump is no longer inclined to maintain the cloak of silence. He is expressly demanding that words become deeds, and rapidly. The European answer is to complain about the allegedly undiplomatic tone set by the US President, and to accuse him of thinking less about the military capabilities of the Alliance than the export opportunities for the American defence industry. These outpourings, however, are helpless, and somewhat pitiable, because the numbers speak clearly for themselves. In 2018 the United States spent 3.5 percent of its gross national product on defence. In addition, only four other NATO partners exceeded the threshold seen as mandatory benchmark: Estonia, Latvia, Greece, and the United Kingdom. Three others, Lithuania, Poland, and Romania, barely missed the target. In fact, the members of the Alliance had all committed themselves in 2014 to attaining the two percent target in 2024. NATO General Secretary Jens Stoltenberg is now hoping that at least half of the states will fulfil their promises. But one should not be overly optimistic; every economic crisis and every rise in the interest rate (the departure from the zero interest policy is regarded as long overdue) will restrict the financial scope of the states still further, and experience has shown that when it comes to cuts it is the military that bleeds first, because this is easiest to push through in terms of domestic policy.

The bargaining for a fair burden sharing is overlaid by a further problem, however, which is of a more fundamental nature. The Alliance, soon to have 30 members, has grown to a size at which it can no longer disregard the fact that there are different interpretations as to which security threats are to be regarded as the priority. The Baltic states, Poland, and also Romania, regard, and for good reason, Russia's hegemony policy as the primary danger, and they expect the Alliance to credibly confirm its commitment to mutual assistance. In turn, the southern European states are watching with concern the developments on the African continent. What they fear, however, are not military threats. Political mayhem and economic development which is too slow in relation to population growth give rise to instability becoming visible in migration movements which are already almost beyond control. Turkey, on the south-east flank of the Alliance, is confronted by conflicts in the immediate neighbourhood, and terrorist threats as well, and can hardly expect NATO to make a contribution to overcoming them. With the contention that they are pursuing a 360 degree approach to security, in other words not only to the east but to all points of the compass, the Alliance has been trying to bring all these different concerns under one roof. But this is not really convincing. Credible are only its ambitions to discourage Russia from adventurism, because in the first instance this involves traditional military deterrence, and above that protection against disinformation and attacks in cyberspace. All other challenges to security and stability in which civil instruments, as, above all, economic means, need to come into effect, exceed its capabilities. If there has to be established a real worksharing between NATO and the European Union, this is where it is to be sought.

Peter Bossdorf

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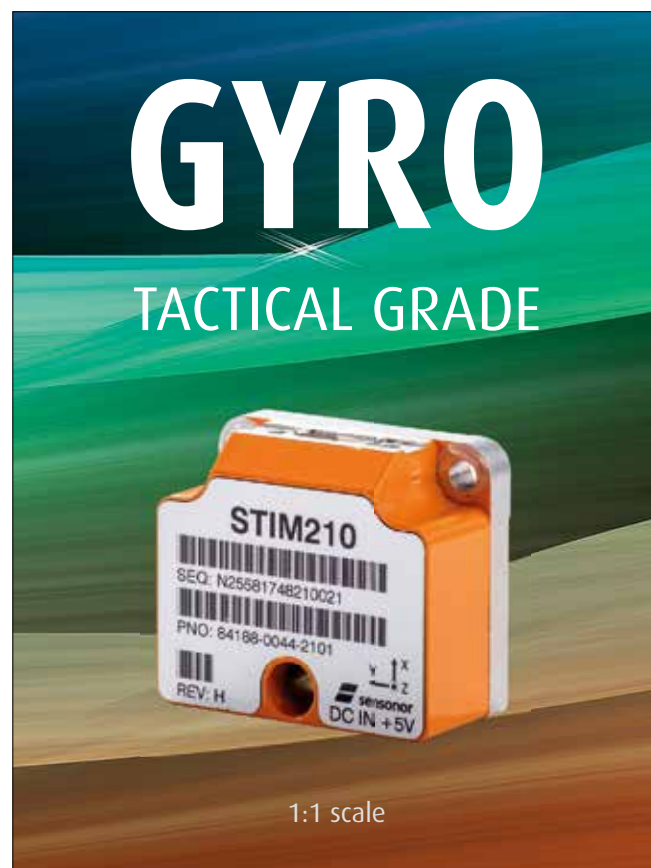
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■ Red Dot Sights for US Army

(ck) The US military contracted Aimpoint, the manufacturer of Red Dot sights, to supply the Aimpoint FCS13-RE fire control system. The contract has a total value of US\$24M. The system will be used with the new M3-E1 MAAWS lightweight 84mm CARL GUSTAF anti-armour weapon from SAAB Dynamics. The FCS13-RE is a direct view dynamic universal reflex sight, which

Photo: Aimpoint



utilises an integrated laser range finder and ballistic computer to give the gunner an aiming point corrected for range, type of munition, terrain angle, and environmental conditions. The system can also be utilised on other crew served weapons including 40mm high velocity grenade launchers, and 12.7mm (.50 caliber) heavy machine guns. The FCS13-RE provides a high probability of first-shot hit at both stationary and moving targets. The system can be enhanced with thermal imagers and is compatible with all generations of military night vision equipment. Deliveries are scheduled for 2019. The system will be fielded by the US Army, US Marine Corps, and US Special Operations Command.

■ Brazil to Order H135s

(ck) The Brazilian Navy has ordered three H135 light twin-engine helicopters for a wide range of missions, such as special op-

Photo: Airbus Helicopters



erations, transport of troops and freight, naval inspection, SAR, and medical evacuation. Two of the helicopters will be equipped with aeromedical kits. Other equipment will include a cargo hook, an emergency flotation system, a winch, as well as weather radar. The H135 will replace the current light twin-engine AS355s; they are also earmarked for missions in the scope of the Brazilian

Antarctic Programme. To date, more than 1,280 helicopters of the H135 family are in operation around the globe, having flown 4.9 million flight hours.

■ Pratt & Whitney Engines for US Navy H135s

(ck) Airbus Helicopters selected the Pratt & Whitney PW206B3 engine to power the Airbus H135 helicopter the company is proposing for the US Navy helicopter trainer replacement. Company officials made the announcement at the 2019 Heli Expo industry trade show in Atlanta. Pratt & Whitney engines power a large portion of the H135 fleet flying in North America. The H135, which is IFR certified by the Federal Aviation Administration, allows pilot training in environments and scenarios similar to the Navy's warfighting rotorcraft fleet. The H135 trainer features a HELIONIX avionics system with colour digital multi-function displays, a four-axis autopilot, integrated flight management system, and engines with full au-

Photo: Airbus Helicopters



thority digital engine control and one engine inoperative (OEI) training mode. The H135 is in use with ten military services in nine nations for initial and advanced rotary-wing pilot training. Airbus will manufacture the H135 for the Navy at its production facilities in Columbus, Ms.

■ Flat Panel Gamma Detector

(ck) Radiation detection specialist Arktis Radiations Detectors has developed a flat panel gamma (FPG) detector for radioactive substances. This type of detector allows operators to distinguish dangerous radioactive isotopes from benign ones. The slim form factor of Arktis' new detector means that gamma detectors can now be placed in areas where it was previously unfeasible or untenable for cost reasons. The modest size, weight and power requirements of the FPGs

Photo: Arktis



is to increase the number of locations where the detectors can be fitted. FPGs can easily be fitted in security equipment that allows for the detection of radioactive sources, while one of the most intriguing concepts is "Sensing Walls", where detectors are concealed behind walls or billboards. Integration into other systems is enhanced by having signal processing on board the detector; trials have already been carried out in drone applications, where sensitivity per payload is key.

■ Advanced Survivability for VAB Mk3

(ck) At IDEX 2019, ARQUUS introduced its Advanced Survivability System fitted on a Véhicule de l'Avant Blindé (VAB) Mk3. The VAB infantry fighting vehicle has been the battle horse of the French Army for decades. The new VAB Mk3 is a family of 6x6 medium weight armoured vehicles offering high mobility, protection and payload. The Advanced Survivability System is thought as a complete system designed to make the VAB Mk3 the best in class protected combat vehicle. The system makes the VAB Mk3 the first vehicle protected against tandem warhead threats. The integrated systems aboard the vehicle detect the impact of warheads on the hull and launch countermeasures which neutralise the tandem warhead effect. The Véhicule de l'Avant Blindé has a low profile which provides for stealth in all terrains, and it comes with new ballistic and mine protection features which improve the protection of the vehicle and its crew against all conventional threats of the battlefield. To ensure the best possible level of tactical awareness, the VAB Mk3 has also been equipped with ARQUUS' own BATTLENET information and communication system.

Photo: Peter Bosdorf



■ Drone Detection On-The-Move

(ck) In response to the growing threat of hostile UAS and other air threats, AVT Australia has introduced its Expeditionary Mobile Air Defence Integrated System (X-MADIS) for on-the-move, mobile and fixed site applications. X-MADIS is a portable solution that detects, identifies, tracks, and defeats airborne threats, including improvised armed UAS and UAS swarms. X-MADIS is a battle-



Photo: AVT

proven and rugged solution, providing protection both on the move and in fixed locations. It is a platform agnostic, multi-mission solution that achieves long-range airborne threat detection, identification and defeat while moving at speeds exceeding 40mph. The X-MADIS' mission set includes VIP protection, combat operations, and civilian facility protection for security, military and law enforcement personnel. Several systems are currently in operation in the Middle East.

■ Rifle Stock for French Police Elite

(ck) Riot and ballistic face shields are essential for law enforcement officers. The problem with these face shields is that once fully lowered they interfere with the assault rifles and/or less-lethal baton round guns

that armed officers are equipped with. For this reason, BCB International has designed an adjustable and foldable stock called FRAMM that allows firearms officers to comfortably shoulder, aim and discharge their firearms in all firing positions while wearing a ballistic helmet with the visor fully lowered. At a press of a button, FRAMM enables an officer to switch from a classic straight alignment to a lowered setting thereby eliminating the risk of their helmet visors interfering with the aiming and firing of their weapon. The French



Photo: BCB International

elite police tactical unit GIGN has selected the FRAMM modular stock for their H&K G36 and HK-UMP rifles. The production of FRAMM variants for other firearms is planned in the near future.

■ Hydraulic Equipment for the Royal Navy

(ck) The UK MoD has awarded Babcock International a contract to supply hydraulic equipment on board the Royal Navy's surface ships and submarines. Under the terms of the contract, Babcock will utilise its engineering capabilities to maintain, repair and manage the systems and equipment, ensuring they meet customer standards. The five-year contract, with a two-year option, will include new manufactured equipment spares supply, equipment repairs and the provision of ad-hoc technical services for ongoing post design activities. The work will be carried out by a team of technicians drawing on their hydraulic repairs and overhaul capability in the Combined Weapons and Equipment Workshop (CWEW) facility. This facility already undertakes a range of hydraulic work in support of both ships and submarines maintenance periods.

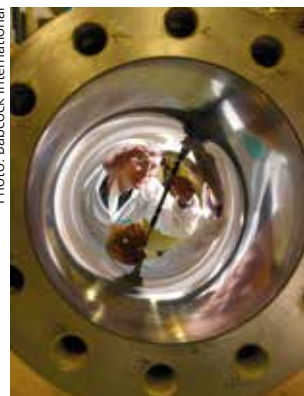
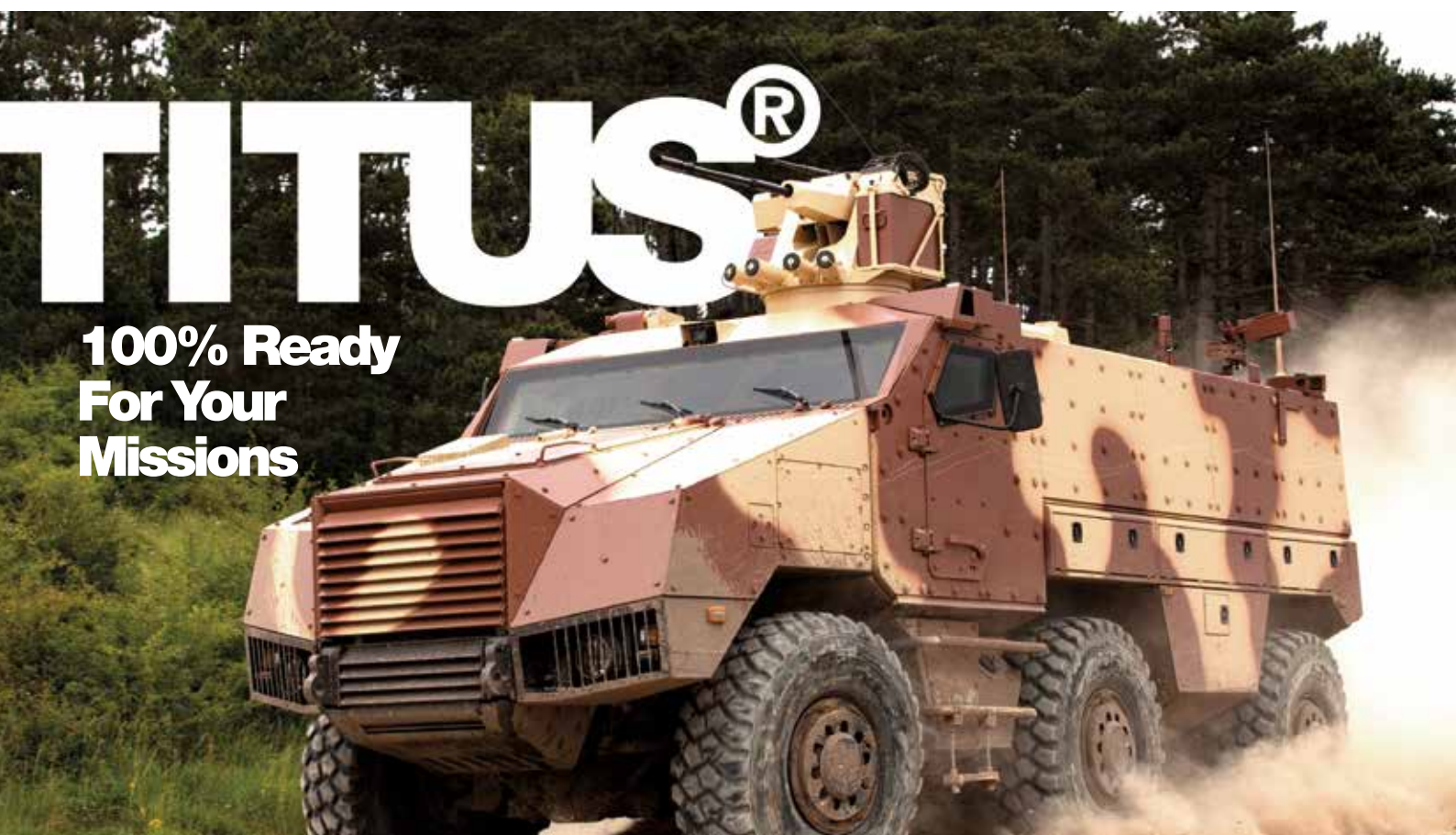


Photo: Babcock International



■ Twelve Mine Hunters for Belgian and Dutch Navies

(ck) Following a call for tenders launched in the summer of 2018, Belgium has selected the Belgium Naval & Robotics consortium, consisting of Naval Group and ECA Robotics, for the supply of twelve mine-hunting vessels and their toolbox (payloads). Six ships are for the Belgian navy; the other six will be delivered to the Dutch navy. The contract with a value of almost €2Bn will last 10 years.



Photo: Belgium Naval and Robotics

■ Maritime Surveillance Systems for Asian Coast Guard

(ck) CONTROP Precision Technologies, a company specialising in the field of electro-optics (EO) and infrared (IR) defence and homeland security solutions, will equip an Asian country's coast guard with its ISEA EO/IR maritime surveillance payloads. The systems will be deployed on several maritime vessels beginning in 2019 for territorial water protection missions. The easy-to-install, easy-to-operate systems include a long-range thermal camera, a high definition (HD) visible surveillance camera, and an eye-safe laser range finder (ELRF). The system features advanced image processing and video enhancement algorithms, automatic video tracker (AVT) and an automatic gain control (AGC). The gyro-stabilised camera systems provide clear day and night images at very long distances.



Photo: Controp

■ Lightweight SDR Manpack

(ck) Building on its Software-Defined Radio (SDR) products, Codan Communications has developed a new manpack, the SENTRY-H 6110-MP. Codan's focus is on providing customers only the feature set the company sees as necessary while avoiding costly features



Photo: Codan

which are rarely utilised. This focus has made the SENTRY one of the smallest and lightest manpacks currently available. It complements Codan's other SDR communication and data interoperability products to specifically address the tactical defence market. The SENTRY-H 6110-MP software-defined manpack integrates recent technology allowing for ease of use and quicker upgrades.

■ Unsinkable Naval Drone

(ck) ECA GROUP, in collaboration with its subsidiary MAURIC, has added a new Unmanned Surface Vehicle (USV) to its range of naval drones. The new INSPECTOR 125 is designed for high seas operations and defence missions such as mine countermeasures, anti-submarine warfare, intelligence/surveillance/reconnaissance or forces support and protection. Combining a MAURIC V2 NG



Image: ECA

rescue boat with an ECA drone kit, INSPECTOR 125 is designed to be unsinkable even after damage. The platform is propelled by two 410hp engines allowing a top speed of over 25 knots. It features autonomous navigation capabilities as well as several launch and recovery systems for various drones. With a length of 12.3m and an overall width of 4.2m, INSPECTOR 125 can carry up to 3 tonnes of payload. Its large rear deck, its mast and underwater pole allow carrying payloads and sensors. INSPECTOR 125 can be operated and deployed from a ship or from ashore and is also air-transportable.

■ New Ground Control Station for MQ-9 REAPER

(ck) The US Air Force's new Block 50 Ground Control Station (GCS) developed by General Atomics Aeronautical Systems (GA-ASI) for the first time controlled an MQ-9 REAPER from the GA-ASI Gray Butte Flight Operations Facility near Palmdale, Calif. The Block 50 GCS cockpit has improved capabilities through a human-machine interface that enhances aircrew situational awareness and allows for single seat operations. It integrates multi-level security feeds with onboard sensors to display a comprehensive picture of the battlespace and it has improved information assurance capabilities that protect against cybersecurity risks. The Block 50



Photo: GA-ASI

GCS promises to reduce manpower requirements; it provides separation of flight critical components to increase flight safety posture, and it features an intuitive glass cockpit design that reduces operator workload through electronic checklists and integrated mission data information displays.

■ Bavarian Police to Select FN SCAR Rifle

(ck) The Police of the German State of Bavaria has selected the FN SCAR-L as their next rifle (Mitteldistanzwaffe). The semi-auto weapon features a 13" barrel, Key-Mod receiver, and RFID tag integrated into the receiver. The RFID tag is an electronic system developed by FN Herstal that allows digital identification of the weapon, hence enabling optimised inventory and in-and-out management of the weapon fleet. The RFID tag can be integrated in any FN SCAR weapon, including precision rifles. Moreover, FN Herstal's new FN SCAR-SC subcompact carbine in 5.56x45mm (.223)



Photo: FN Herstal

designed for law enforcement personnel is now also available in 7.62x35mm (.300 BLK) calibre. It features a standard telescopic buttstock and is available with a wide choice of accessories.

■ New Loitering Munition

(ck) Israel Aerospace Industries (IAI) has developed loitering munition called MINI HARPY, which combines the capabilities of IAI's HAROP and the HARPY missiles, offering detection of broadcast radiation with electro-optical capabilities. The MINI HARPY



Photo: IAI



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can neutralise radiation emitting threats and detect electro-optical threats with high quality video footage for the operator. The munition can be launched from mobile land and naval platforms. MINI HARPY thus provides independence in intelligence collection for an updated situational picture. The missiles are launched towards the target area where they loiter in the sky until the threat is detected. Upon detection, the system locks on to the threat and attacks it for quick, lethal execution. The system was designed to provide operators with control up to the last moment, including cessation of attack at any stage. Electrically powered, it is quiet and operates in a mission range of 100 km for the duration of two hours.

■ Self-Protection Module for Surface Ships

(ck) At Navdex 2019, MBDA presented the SPIMM (Self-Protection Integrated MISTRAL Module), an all-in-one air defence module based on the SIMBAD-RC system and designed to equip surface ships of all types, particularly those without a combat system, such as supply ships. The SPIMM module



Photo: MBDA

consists of a SIMBAD-RC automated naval turret equipped with two ready-to-fire MISTRAL missiles and a 360° infrared panoramic system to detect and track air and surface threats. The system is entirely controlled by two operators located in a shelter inside the module which can be positioned on the deck of a ship using a crane. Designed to protect surface vessels against conventional airborne threats (anti-ship missiles, combat aircraft, helicopters and UAVs), the SIMBAD-RC and MISTRAL can neutralise asymmetric threats such as Fast Inshore Attack Craft (FIAC).

■ UAE to Buy MBOMBE 4 APC

(ck) The United Arab Emirates (UAE) will procure Paramount Group's newly launched MBOMBE 4 armoured personnel carrier (APC). The MBOMBE 4 is based on the MBOMBE 8x8, now in production following its launch in 2016, and the MBOMBE 6x6, which has entered service. Displaying a new design and featuring recent technologies, the MBOMBE 4 offers high levels of ballistic and mine protection (e.g. crew compartment STANAG 4569-Level 3, blast pro-



Photo: Paramount

tection STANAG 4569-Level 4a & 4b) and protection against a 50 kg TNT side blast or IED/roadside bomb. Its applique armour packages can provide higher levels of ballistic protection (up to level 4) and mine protection when needed. Another key feature is a burst speed of 140 km/h and a rear-door ramp proven in combat on 6x6 and 8x8 IFVs. The 16 tonne vehicle offers a payload of nearly three tonnes, encapsulating weapon systems, ammunition, crew and supplies. The MBOMBE 4 can accommodate a wide range of payloads and turrets, and its mission computer and interface system is able to integrate with both western and eastern-made weapon systems.

■ Night Vision Binoculars for the German Army

(ck) To bolster their night operations capability, the German armed forces have contracted the French company Photonis to supply 1,700 night vision binoculars with modern image intensifier tubes. The Photonis 4G high FOM image intensifier tubes will be integrated with Theon Sensors' new NYX binoculars. 4G image intensification technology increases the ability to locate and engage threats under all night conditions. The 4G standard is the latest technology in intensified night vision as it provides the highest performance possible for

Photo: Photonis



driving at night; it is designed to address the stringent requirements of special forces operators. Only 4G can offer ultra-fast auto-gating, the smallest halo and unrivalled spectral range from ultraviolet to near infrared.

■ New Air-to-Surface Missile

(ck) Rafael has developed a new long-range stand-off air-to-surface missile. Based on Rafael's SPICE, ROCKS is an air-to-surface missile, which may be used against high value stationary and mobile targets, even in theatres where the enemy employs effective GPS countermeasures. Equipped with either a penetration or blast fragmentation warhead, the missile can destroy above-ground

or underground targets in heavily surface-to-air-defended areas. ROCKS is launched well outside of the enemy's air-defence coverage area, and performs a high velocity trajectory towards the target. This minimises the launch aircraft exposure to threats. ROCKS uses its INS/GPS for midcourse navigation, while homing on to the target is performed by using its EO seeker and advanced image processing algorithms, which ensures hitting

Photo: Rafael



targets with great precision, overcoming GPS jamming or denial. ROCKS answers a growing demand for long range, GPS-independent air-to-ground precision strike capability.

■ LYNX on Offer to Australia

(ck) Under the Land 400 Phase 3 Programme, Australia is looking to procure a mounted close combat capability and has issued a Request For Tender (RFT). Rheinmetall will offer its LYNX Infantry Fighting Vehicle (IFV) with the LANCE turret and the LYNX Manoeuvre Support Vehicle (MSV) to the Australian Army. The LYNX IFV and the LYNX MSV have a modular architecture which means that only two LYNX base vehicle configura-

Photo: Rheinmetall



tions are required to achieve the nine roles sought under the Australian Army's RFT. LYNX provides protection against blast, IED, direct and indirect fire, cluster munitions, and anti-tank guided missiles. The IFV has a crew of three and provides room for six dismounts. The Rheinmetall LANCE turret has already been contracted to be delivered to the Australian Army under Land 400 Phase 2, and will be manufactured in Brisbane. The digital LANCE turret provides the crew with sensor systems, advanced automatic tracking and targeting capabilities, and weapon integrated battle management.

■ New Laser Weapon Station

(ck) In December 2018, Rheinmetall successfully conducted trials with a laser weapon station. The weapon station can

be armed with lasers in the 100 kW output power range. During the tests conducted at the company's test centre in Switzerland,



Photo: Rheinmetall

drones and mortar rounds were engaged at operationally relevant ranges. The laser weapon station consists of four components: the laser source, beam director with the telescope, and course tracker (weapon station). The mobile weapon station performs the task of mechanically aiming the laser toward the target. The laser weapon station was combined with a beam director and high-performance Rheinmetall lasers. It is also designed to be combined with a soon-to-be-available 20 kW laser source, likewise made by Rheinmetall. Among the laser weapon station's performance parameters are its accurate mechanical aiming function, coupled with an unlimited, 360° traversing zone and an elevation range in excess of 270°. The system is oriented to the MANTIS air defence system now in service with the German armed forces, and thus offers interfaces for connecting it to higher-echelon air defence

■ Schiebel CAMCOPTER Tested on Nigerian Pipeline

(ck) The international oil and gas industry is increasingly interested in using UAS to monitor and control the oil and gas infrastructure. Therefore, in January 2019, a European oil and gas company tested the Schiebel CAMCOPTER S-100 off the coast of Rivers State to investigate the advantages of UAS technology. The event was attended by repre-



Photo: Schiebel

sentatives of the Nigerian Air Force, Nigerian Navy, Nigerian Army, Kongsberg Geospatial and local UAS service provider Aerial Robotics. The Vertical Takeoff and Landing (VTOL) CAMCOPTER UAS is designed to improve intelligence, surveillance and reconnaissance (ISR) missions in an oil and gas production environment. The CAMCOPTER performed day and night flights to monitor pipeline routeability (ROW), inspect oil and gas well-heads and equipment, and perform first line maintenance inspections. The CAMCOPTER was also able to detect illegal activities on the customer's pipeline. Kongsberg Geospatial's IRIS UAS application supported the safe execution of this Beyond Visual Line Of

Sight (BVLOS) operation. The CAMCOPTER S-100 does not require any prepared surfaces or support equipment for take-off and landing. It works day and night, in adverse weather conditions, with a range of 200 km. The carbon fiber and titanium hull offers space for a variety of payloads. In a typical configuration, the CAMCOPTER S-100 carries a payload of 34 kg up to 10 hours. High-resolution images are transmitted to the control centre in real time.

■ Off-Grid Power for International Defence Organisation

(ck) SFC Energy, a provider of off-grid power solutions, has delivered a major order of SFC Energy's portable JENNY fuel cells to an international defence organisation. The delivery has a total value of over €1M. This is the second batch of JENNYs 1200 sold to this organisation. The fuel cells are used in multi-day missions and help the soldiers save up to 80 % of carry-along weight. The portable JENNY 1200 fuel cell with a nominal power of 50 W is based on direct methanol fuel cell technology. Advantages of the system are no spare batteries to be carried by soldiers, automatic clean battery recharge, no noise and maintenance, almost no detectable heat signature, and a lower cost of ownership.

Photo: SFC Energy



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MOTOR SICH at AERO 2019

MOTOR SICH JSC is a company specialising in the development, production, and after-sales service of aircraft gas turbine engines, industrial gas turbine drives and gas turbine power plants.

Recently, the company has also actively supported the development of a helicopter-building industry in Ukraine.

The company has an Experimental Design Bureau certified by the State Aviation Administration of Ukraine as a designer.

MOTOR SICH JSC has developed its own scientific and technical base for design, manufacture, tests and certification of helicopters.

Currently, the list of MOTOR SICH engines in commercial production and at various stages of development for passenger, transport, and military transport aircraft includes:

- Turboprop and turboprop-fan engines of 400 to 14,000 hp, with the most advanced engine of this type being the type D-27, the only turboprop-fan in the world;
- Bypass engines of 1,500 to 23,400 kgf. It is pertinent to highlight the D-18T engine designed for Ruslan and Mriya cargo aircraft that possess the greatest cargo capacity worldwide, with their payloads being 150 and 250 tons, respectively.

MOTOR SICH is currently producing the D-436 bypass engines for the An-148 and An-158 passenger aircraft, the Be-200 amphibious aircraft and the new An-178 transport aircraft. The company also participates in the work carried out by GP Ivchenko-Progress Design Agency to upgrade the D-18T and D-136 engines and to develop the AI-28 engine of 9 to 11 tons of thrust with a geared fan drive.

MOTOR SICH JSC is the world leader in the production of turboshaft engines for helicopters. The company produces a wide range of helicopter engines, including the TV3-117V family of engines that power practically all medium Mi and Ka helicopters in 96 countries worldwide; also, the world's most powerful D-136 engine designed for the Mi-26 helicopter, the world's most powerful helicopter.



Photos: MOTOR SICH JSC

Vyacheslav A. Boguslayev
President, MOTOR SICH JSC

MOTOR SICH JSC has produced more than 30 thousand helicopter engines of the TV3-117V family, and it is permanently working to improve them. To improve helicopter flight performance, the company has developed the new TV3-117VMA-SBM1V engine that paved the way for the engine family.

Today, small aircraft are in high demand in the world; against this background, MOTOR SICH JSC is involved in the work carried out by Ivchenko-Progress to develop small turboshaft and turboprop engines of the AI-450 family.

On 15 April 2015, the AI-450M engine version obtained the Type Certificate issued by the Aviation Register of the Interstate Aviation Committee (IAC), with engine takeoff power being 400 hp, 430 hp or 465 hp depending on the configuration of its automatic control system.

At the same time, work is underway on the AI-450C and AI-450C-2 turboprop



versions with a takeoff power of 450 to 495 and 630 to 750 hp. respectively; the engines are designed for general purpose airplanes and training aircraft, including the aerobatic category (the AI-450CP and AI-450CP-2 engine versions).

In 2017, Type Certificate was obtained for the engines of the AI-450C family, and in 2018 for the AI-450CP engine.

It should be noted that the work on the development of these engines was initiated by Mr. Christian Dries who is well-known to many participants of AERO. At that time, he headed Diamond Aircraft Industry, and his engineering talent and high organisational skills made it possible to develop the DA50-JP7 seven-seat demonstration aircraft powered by these engines and the DART-450 training aircraft which is currently in production.

Under the leadership of Mr. Dries, projects were launched to develop several new aircraft powered by MOTOR SICH engines. Unfortunately, a change of ownership of Diamond in 2018 suspended these works (we hope that the suspension would be temporary).

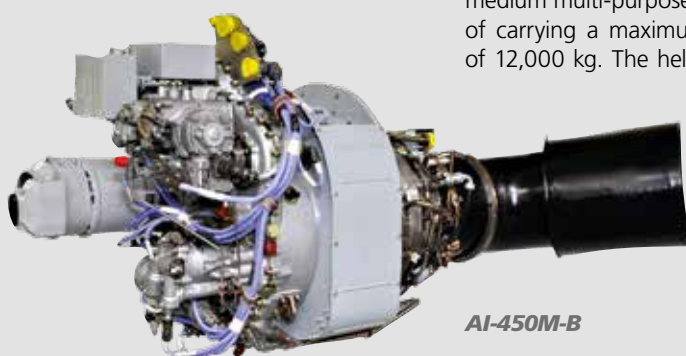
The AI-450C engine is used in a programme carried out by MOTOR SICH JSC to re-engine the Yak-52 trainer (UTL-450 project). The company hopes that this project will also be of interest for AEROSTAR S.A., Romania, which has built more than 1,900 airplanes of this type and continues to do so.

MOTOR SICH JSC, together with Antonov State Enterprise, carried out work to upgrade the An-2 aircraft, the general purpose "veteran" aircraft. In addition to installing the MS-14 turboprop engine of 1,500 hp instead of the ASH-62 piston engine, the propeller and navigation equipment were replaced in the aircraft. The aircraft was certified and received the designation An-2-100. It is powered by a

new powerful engine that improves the aircraft's manoeuvrability, increases the load capacity, flight altitude and range. Today, the company is working to develop a family of MS-500V new generation turboshaft engines with a take-off power of 600 to 1,100 hp. The engine is designed for helicopters that have a take-off weight of 3.5 to 6 tons.

The MS-500V and MS-500V-01 engine versions, which have a take-off power of 630 hp and 810 hp respectively, were certified with Type Certificates issued by the Aviation Register of IAC.

The development of some other engine versions is underway: the MS-500V-02 engine version with a take-off power of 1,050 hp and the MS-500V-03 engine version with a take-off power of 950 hp. Also, work is underway on the MS-500V-S turboprop engine versions



AI-450M-B

with a take-off power of 950 to 1,050 hp, which are designed for general purpose aviation, trainers and passenger aircraft. For example, in MOTOR SICH opinion, they may be successfully used in the project of the D6 single-engine nine-seat aircraft developed by CZECH GENERAL AIRCRAFT, Czech Republic, and other similar projects of single and twin-engine aircraft.

The helicopter production of MOTOR SICH JSC includes mechanical and assembly shops equipped with modern equipment, an area for removing and applying paint coatings, the flight test complex, and the training centre to train crews for all types of the helicopters manufactured.

The first project implemented within the scope of the MOTOR SICH helicopter programme was the Mi-8MSB helicopter, a medium multi-purpose helicopter capable of carrying a maximum take-off weight of 12,000 kg. The helicopter is equipped

with a powerplant consisting of two TV3-117VMA-SBM1V 4E series gas turbine engines with electric start.

Powered by TV3-117VMA-SBM1V 4E series engines,

the Mi-8MSB helicopter set a number of world records, including the absolute record for level flight altitude of 9,155 m in the E1 class, which is 300 m higher than Mount Everest, the world's highest mountain peak.

The helicopter is equipped with a modern navigation system that meets EASA and ICAO requirements.

Another vector of the MOTOR SICH helicopter programme is the development and

production of light helicopters. The first certified helicopter developed by MOTOR SICH JSC in this class was the Mi-2 helicopter powered by AI-450M-B engines.

The helicopter instrumentation includes digital displays of engine parameters. A new set of onboard equipment, such as a "glass cabin", may be installed.

On 18 April, 2016, powered by AI-450M-B engines, the Mi-2 helicopter set a record: it overcame an altitude of 7,000 meters. The MSB-2 light multipurpose helicopter is unified partially with the Mi-2 helicopter: both helicopters are powered by AI-450M-B engines. However, the MSB-2 helicopter is powered by more powerful AI-450M-P engines generating 465 hp each, and it is equipped with a new transmission based on the VR-442 main gearbox.

MOTOR SICH JSC has manufactured the first helicopter which is currently under tests, ground and flight.

Today, the MOTOR SICH JSC activities fully meet current economic criteria.

The company's strategy is aimed at increasing production output and sales, upgrade of products, development and commercialisation of serial manufacture of brand new promising products and expansion of markets.

For more information please visit our site: <http://www.motorsich.com>



Mi-2 helicopter powered by AI-450M-B engines

The US and NATO: What Lies Ahead?

John Antal

Are we headed for a new war in Europe? In light of a resurgent Russia, this is the serious question that many diplomats and military officers are asking today.

On 16 February 2019, Belarusian President Alexander Lukashenko declared that Belarus was ready to unite with Russia anytime, as agreed to in the 1999 Union Treaty. It is worth remembering that Lukashenko was the leader of Belarus in 1999 who signed the 1999 Union Treaty and remains the undisputed dictator-for-life to this day. Lukashenko's announcement may move both countries closer to a possible new Russian-Belarusian confederation. Such a union would most likely be led by Vladimir Putin. Since such an arrange-

ment would trump the Russian constitution, which precludes Putin from assuming the presidency of the Russian Federation in 2024, Putin could place himself in power as the leader of the newly declared Russian-Belarusian Union and fulfil his desire to be leader-for-life like his friend Lukashenko.

A Russian-Belarusian Union

If the two countries join, the Union of Russia and Belarus would create a powerful new geopolitical calculus. While this possible amalgamation looms, Russia remains active, planning several steps ahead. In the strategic Russian military exclave in Kaliningrad, the

munitions, fuel-air explosives, high explosive-fragmentation, a bunker-busting earth penetrator munition, an anti-radar electromagnetic pulse device, a cruise missile, and most importantly, a nuclear warhead. Russia has also deployed advanced Russian S-400 air defence systems and the BAL and BASTION coastal defence missile systems. Even more threatening, satellite images of the exclave in late 2018 confirmed that the existing nuclear weapons storage bunkers from the Cold War have been modernised. With such an arsenal, the Russian Kaliningrad military complex will be able to influence a vast area including much of Poland, all the Baltic States, and most of the Baltic Sea.

Another Cuban Missile Crisis?

Kaliningrad has a population of nearly a million Russian citizens and a total area of 15,100 sq km. It was formerly the city of Königsberg and the capital of the old German State of Prussia. It has now become the world's newest flashpoint. As an exclave, it is further isolated from Belarus and Russia by NATO nations. To move supplies overland to Kaliningrad, Russia must transit the NATO countries of Lithuania, Estonia, Latvia, and Poland, or Poland and Belarus, depending on the route. Russia yearns for a land bridge and to have complete control of the territory from Kaliningrad to Belarus. In 1991, Russia and Lithuania agreed to access rights for Russia to transit Lithuanian territory at regulated times from Belarus to Kaliningrad. This transit takes place along a narrow strip of land called the Suwalki Corridor, a 65-mile stretch from Belarus to Kaliningrad along the Poland-Lithuania border. Only an hour's drive halts Kaliningrad's physical reunification with Russia.

Since Russia's annexation of Crimea in 2014, tensions have risen and NATO has suspended all practical military and civilian cooperation with Russia. Alarmed by Russia's aggressive moves, the Baltic States have increased their defence spending and readiness. Lithuania and Poland have pledged to raise their defence spending to 2.5% of GDP by 2030. In March 2018, Poland made an agreement with the US Government to purchase two PATRIOT Configuration 3+ batteries for deliveries in 2022 for US\$4.75Bn. In April 2018, Russian officials warned that NATO had crossed a 'Red Line' with the expansion of NATO and what they perceive as the "grow-

Photos: US Army



US Soldiers conducting a live-fire exercise at Bemowo Piskie Training Area in Northeast Poland in February 2019. NATO's "Enhanced Forward Presence Battle Group Poland" is comprised of US, UK, Croatian and Romanian soldiers.

ment would trump the Russian constitution, which precludes Putin from assuming the presidency of the Russian Federation in

Russians have reinforced, upgraded, and hardened key facilities. Situated on the Baltic Sea coast, a leftover from the Cold War, Kaliningrad is a vital position for Putin, as it is Russia's last foothold in formerly Soviet lands, and its vital naval base is the home of the Russian Baltic Fleet, which consists of 56 warships. The exclave also includes a strong Russian Army garrison and a robust and sophisticated A2/AD (Anti-Access/Area Denial) missile complex. Reports that Russia has moved the 500 km-range ISKANDER-M missiles to Kaliningrad have increased tensions. The ISKANDER-M, designated as the SS-26 STONE by NATO, can carry a variety of conventional warheads, including cluster

Author

John Antal is an expert on military affairs. He has published 14 books on military and leadership subjects and over 500 articles in military professional journals. He served 30 years as a soldier in the US Army, retiring as a colonel, having commanded combat arms units from platoon to brigade.



US Secretary of State, Michael Pompeo, Poland's Minister of Foreign Affairs, Jacek Czaputowicz, and Poland's Deputy Minister of Defence, Marek Lapinski, visited NATO's Enhanced Forward Presence, Battle Group Poland on 6 February 2019.

ing militarisation of Poland". Russia's deputy foreign minister Alexander Grushko stated: "Not only in politics, but also in the field of military development, NATO began resorting to Cold War schemes that should have been left in the past". According to the Moscow Times on 19 October 2018, Putin has "unveiled an array of new nuclear weapons in one of his most bellicose speeches in years, saying they could hit almost any point in the world and not be intercepted". To emphasise Putin's power, the Moscow Times headlines for 21 February 2019, read: "I'm Ready for Another Cuban Missile Crisis if You Want One, Putin Tells US."

The US and its Allies are listening and have been monitoring this situation carefully. The US has argued that the cruise missile version of the ISKANDER, the SSC-8

R-500 ISKANDER-K, violates the Intermediate-Range Nuclear Forces (INF) Treaty as its estimated range is beyond 500 km. This, along with the deployment of other short-range Russian missiles, was one of the reasons the US backed out of the INF treaty on 2 February 2019, following an

announcement the day before by US Secretary of State Mike Pompeo.

A Resurgent Russia

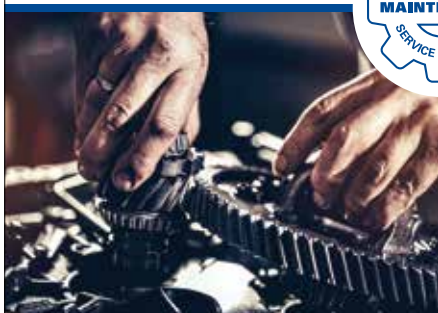
These developments in Belarus, Russia, and Kaliningrad are a primary concern for NATO. As the Soviet Union collapsed, many countries of the former Soviet Union sought independence. Lithuania, Latvia, and Estonia gained their freedom and NATO added these Baltic States to the Alliance in 1999. A succession of East-West crises – Russia's war in Georgia in 2008, the annexation of Crimea in 2014, the continuing Russian-led proxy war in Ukraine, and the downing of Malaysia Airlines Flight 17 (MH17) on 17 July 2014 (in May 2018 the BBC reported that the Joint Investigation Team reported: "All

the vehicles in a convoy carrying the missile were part of the Russian armed forces") – the chances of a military clash between NATO and the Russian Federation have increased. From a resurgent Russia's point of view in 2019, the status quo of NATO moving ever closer to Russia is unacceptable. Breaking NATO, then, would be a significant gain for Moscow. If Russia were to seize the Suwalki Corridor in a quick stab-and-grab operation, for example, the Baltic NATO states would be cut off from the rest of NATO. In Article 5 of the NATO Alliance Treaty, each member has pledged that an attack on one is an attack on all. If NATO did not or could not respond, and Russia was to prove Article 5 a hollow promise, then the independence of the Baltic States and the future of the NATO Alliance would be in jeopardy.

Credible Deterrence

The US and NATO are alert to this threat. If NATO is to deter war, it must continue to improve its presence and capabilities to defend the Suwalki Corridor. The US, regardless of what you read in some of the American press reports, is fully committed to the NATO Alliance. President Donald Trump recognises the danger and wants NATO members to step up their defence spending to the levels they have previously pledged. As Kori Schake wrote

GENERAL DYNAMICS European Land Systems



in his article "NATO Without America", some European NATO members have responded to President Donald Trump's exhortation that each member meet their 2% spending obligation as "How dare they?" not "How dare we?" It is far past time for every member of the Alliance to get serious, pull their own weight, and pay their pledged amount. Arguing over military budgets aside, the Alliance members pledged on 7 June 2018, to the NATO Readiness Initiative where each member state committed, by 2020, to support a force of 30 battalions, 30 air squadrons, and 30 naval combat vessels ready to use within 30 days, to move within Europe and across the Atlantic – to respond to a security emergency in Europe. This is a major step toward creating a credible deterrent force, but it is not enough. If you want peace, you must prepare for war, and NATO's defences are currently inadequate to deter a determined Russian attempt to seize the corridor, declare a ceasefire and wait and see if NATO will respond.

On 22 February 2019, the US Secretary of State Mike R. Pompeo visited Poland and watched NATO forces training at the Bemowo Piskie Training Area. His words reinforced the purpose of the NATO Alli-

ance and emphasised America's commitment to its allies to deter war and maintain the peace. "As we enter the fifth year of Vladimir Putin's war on Ukraine, a war he launched on European soil, we take seriously those concerns that Russia may one day try to open a front along a line right here. In light of this threat, the NATO alliance remains indispensable for the protection of the free peoples of Europe.... Now, it is every ally's responsibility to keep Europe free. Russia has grand designs of dominating Europe and reasserting its influence on the world stage. Vladimir Putin seeks to splinter the NATO alliance, weaken the United States, and disrupt Western democracies. Russia's invasions of Georgia and Ukraine, its unprovoked attack on Ukrainian naval vessels in the Black Sea this past November, and its ongoing hybrid warfare against us and our allies are direct challenges to our security and to our way of life.... Those threats must be met with similarly strong commitments from each and every NATO ally".

Fear is a reaction, courage is a decision. The Cold War may be over, but a new, equally dangerous situation has emerged. It seems clear that NATO will be tested in the months and years ahead. The reality facing all members of the Alliance is that

Europe and America need NATO. We share democratic values, military standards, a unified command structure, and NATO can put together effective multinational forces better than any other alliance in the world. The seventy-year Alliance is, by far, the most successful political and military alliance in history and every member nation should consider this fact. As for the US, America has consistently shown its commitment to the Alliance and to NATO's founding ideals of preserving the peace in Europe. As Secretary Pompeo emphasised in Poland in February 2019, "the men who set NATO's foundation were determined that Europe would never again face tyranny and war." As the fears of the old Cold War have been replaced by a resurgent Russia that might take military action in Eastern Europe, there is much to consider. Is NATO ready for what lies ahead? Can NATO still deter war and, if deterrence fails, fight and win as a unified Alliance? It can, but only if every member nation plays its part, leads by example to pay its pledged share, and acts with courage. NATO members have overcome disagreements before. In the face of these new challenges, every member of the NATO Alliance must stand together and decide on courage. ■

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Viewpoint from London



Photo: Conrad Waters

The Headwinds of Brexit Uncertainty

Conrad Waters

At the time of writing this viewpoint only two weeks remain before the United Kingdom is officially due to leave the European Union.

There is still no clarity as to how, when or even if departure will take place. The resulting political crisis speaks volumes about the inadequacy of Britain's political class to deal with the challenges that confront them. With the country's two main parliamentary parties seemingly vying to trump each other's dysfunctional behaviour, Brexit has become the 'Project Chaos' of the UK's governing elite.

Whatever the ultimate outcome of the current crisis, what is clear is that the aftermath of the UK's Brexit vote is already having significant consequences for European security and defence. From a domestic, British, perspective, the country's previous leading position in Europe's security architecture is being weakened, perhaps irreversibly so. The UK has become seen as a less reliable partner and this is impacting collaboration with allies. For example, the ambitious objectives for strengthened Anglo-French defence cooperation heralded by the 2010 Lancaster House Treaties have been increasingly overtaken by events. Britain's exclusion from European security projects, most notably the encrypted elements of the Galileo satellite programme, will further reduce its influence over time.

The UK is attempting to counter these negative consequences by talking up its worldwide military potential as part of the post-Brexit 'Global Britain' vision. In February 2019, British Defence Secretary Gavin Williamson majored on this theme in a speech entitled 'Defence in Global Britain' given to the Royal United Services Institute (RUSI). Stating that the UK "must be prepared to compete for our interests and our values far, far from home", he announced a range of initiatives. They included the creation of two new littoral strike groups, one to be permanently deployed East of Suez. The establishment of new bases in the Caribbean and the Asia-Pacific region is also being investigated. Ironically, the unanswered question remains whether the British Armed Forces can be provided with the financial resources needed to achieve these ambitions given the economic headwinds produced by Brexit uncertainties.

From a European perspective, the new political backdrop will be seen by some as an opportunity but by others as a threat. For federalists,

the removal of the UK's restraining hand could facilitate a welcome acceleration of moves to develop a true European military. A strengthened Franco-German alliance is likely to be central to this process. This is evidenced by the signature of the Aachen Treaty on 22 January 2019. Although a bilateral document, the agreement has a significant emphasis on developing joint military capabilities to bolster Europe's ability to act autonomously. Subsequently, influential German Christian Democratic Union leader Annegret Kramp-Karrenbauer has proposed a "symbolic project" to build a common European aircraft carrier. It remains to be seen whether the upgraded partnership can overcome fundamental differences in French and German approaches to defence strategy and spending.

Whatever the outcome, the prospect of a closer Franco-German alliance dominating Europe's political and military trajectory is unlikely to receive a universal welcome across the continent. The two partners' flagship project is for the new Future Combat Air System. This will replace the existing EUROFIGHTER and RAFALE jets in the 2040s. French and German dominance of the programme has already drawn the ire of the Italian aerospace sector, which sees its own industrial capabilities being marginalised as a result. For other European countries – notably those to the east – the litmus test of further EU defence integration will be its impact on the stability of the NATO alliance, the final guarantor of their security against a resurgent Russia. The potential loss of the UK's role as an arbiter in EU and NATO relations will be a concern.

Brexit uncertainty comes at a time when European security faces a multitude of challenges. The hazards posed by, for example, mass migration, terrorism, Russian adventurism and US neo-isolationism are diverse in nature. However, all require a considered and well-resourced response. The United Kingdom has brought considerable know-how and capabilities to the EU's efforts to combat these threats and gained much in return. Whatever the outcome of Brexit machinations, it is hard to escape the conclusion that the security of both the UK and the rest of the Europe has been damaged by the Brexit debate.

A Brexit Mural in Dover. The work of street artist Banksy appeared overnight near the Dover/Calais ferry terminal.

Photo: Immanuel Giel





Viewpoint from Dublin

Photo: Tommy Martin



Brexit: It Is Such a Pity

Tommy Martin

There are any number of ways to gauge the mood of the ordinary man and woman in the street, and, frequently, the most accurate is the most unsophisticated – listening to them where you meet them, on trains, taxis, and in public places. The talk in Ireland today is about many things, and just one thing – Brexit. Brexit has been a feature of Irish life for the past two years, but like many things unpalatable, Brexit only began to be taken seriously by Seán and Aíne Citizen as the date for the British withdrawal from the European Union came rapidly into view.

What is interesting about the process of Brexit, irrespective of the final outcome, is just how indecisively it has been managed, communicated and played out in a very public way, with social media strongly influencing public opinion. The minority Governments in both countries, Britain and Ireland, are reliant on a "confidence and supply" arrangement with other parties and individuals. What this has done, is make it much harder to agree a consensus, with each new development having the potential to bring down a government, should it not receive the required support. At a time when dynamic and decisive leadership is needed, governing by agreement and assent has conspired to dilute the effectiveness of the mandates of both governments, increasing the uncertainty of a post-Brexit world.

A Sense of Disbelief

In the immediate aftermath of the 2016 Brexit referendum in Britain, there was a general sense of disbelief in Ireland that Brexit would actually go ahead; or, if it was to go ahead, it was thought that the format of it would be such that it wouldn't really make that much difference to everyday life in Ireland. While there was initial unease about the future status of the open border between the Republic of Ireland and Northern Ireland, the detail of the "backstop" reassured everyone, and Brexit was relegated to a matter of lesser importance in the minds of many. This early optimism has since been replaced with uncertainty, trepidation and genuine concern about what the future may hold. Ireland's history has been bound up with Britain for nigh on 800 years. There isn't a family in Ireland that doesn't have relatives in

Britain. Irish people support English soccer teams and watch British soap operas, with both countries having so much more in common than they realise. As with all neighbours, they have disagreed, but in recent years, and certainly post the 1995 Good Friday Agreement, Ireland and Britain have both acknowledged that what unites them is far stronger than what divides them. Much of the inherent historical suspicions and mistrust, on both sides, have been systematically and cogently eroded, and Britain and Ireland have never had a closer, more harmonious relationship. But the dialogue around Brexit, the hardening of attitudes, and the very public, high-stakes Brexit negotiations have damaged mutual respect.

Thrown under a Bus

Ireland suffered more than most during the worldwide financial crash of 2008, plunging the country into years of recession, austerity, and a loss of confidence of our place in the world. Relations with the European Union were tested, and there was a strong belief amongst ordinary men and women that Ireland was somehow thrown under a bus to protect the European Union dream. That memory has not gone away, and there lingers a nagging doubt in the minds of many, that when push comes to shove on the border and Brexit, Ireland's needs may yet again be sacrificed for the perceived greater good of those with their hands on the levers of power.

Britain's withdrawal from the European Union impacts Ireland most of all – they are our nearest and most important trading partner, we have a shared political and social history, we uniquely share the same language. Britain joined the then European Economic Community in 1973, prompting Ireland to follow suit. Ireland today has matured and developed to such an extent that no serious consideration was given to Ireland following Britain and leaving the European Union. And what do the man and woman on the street say about it all? In Ireland, where free speech and the right to disagree are cherished, the British decision to leave the European Union is respected. But it is such a pity it has come to this – and it could have been handled a whole lot better.

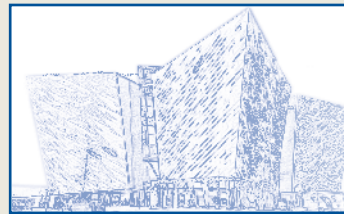


Photo: James Dornan

The Irish Border Poll: We Need Facts

James Dornan

Military expediency dictated that Britain retained an interest in having a foothold in Ireland for many centuries. But on 9 November 1990, Peter Brooke, the then Northern Ireland (NI) Secretary of State, declared that Britain had “no longer any selfish, strategic or economic interest” in NI and would accept unification.”

The Good Friday Agreement (GFA) of 1998 declared that a border poll could be called at the discretion of the Sec. of State, and the fallout of Brexit, allied with the failure of the local legislative Assembly to meet for two years, has brought a persistent call for the same from Sinn Féin (SF) in recent days.

Brexit was not supported by the majority in NI, but the Democratic Unionist Party (DUP), established by the late Rev. Ian Paisley, are the majority party in NI and have been in a strong bond with Mrs May's Tories in recent times with the aim, in their words, of “consolidating the Union”. However, any hardening of the border is likely to do the exact opposite. High risk politics are the current order of the day.

The reader would do well to be informed of the following facts: The DUP have never polled more than 23% of the voting population, and SF never more than 21%. Therefore 56% do not vote for either. Of that 56%, 1/3 never vote, 1/3 vote for “other parties” and 1/3 just vote at important times, such as for the GFA which had a 82% turnout. The latter 1/3 would vote in a border poll.

The current political vacuum has increasingly led to the middle ground finding its voice, and they want to see the GFA implemented fully, and they accept that a border poll could well be called within the next decade, and wish to be presented with clear facts to enable them to vote intelligently rather than on the basis of a slogan written on the side of a bus.

While the DUP and SF will have many in their ranks that would vote with their heart in preference to their heads, the middle 56% are more savvy and could be described as “soft” unionist or nationalist, and more likely to see economic considerations as crucial in any future new dispensation being agreed within these Celtic Islands.

A vote to remove the border would not necessarily lead to a single entity United Ireland, but indeed all outcomes should be considered. The status quo, a new Ireland, an independent Ulster,

and indeed perhaps a new relationship with Scotland could be considered. The times they are a changing and the relationship between England and Scotland is visibly fraying as the former's nationalist body seem to be increasingly and somewhat disturbingly finding its voice.

While all this unfolds, by a combination of inevitability and “events dear boy, events”, the security situation in Ireland will increasingly come under the microscope.

While SF are undoubtedly operating a peaceful, though I would contend a somewhat flawed strategy, there are still perhaps a few hundred in the background who are wedded to using terror to achieve their aims.

The forces and services of the law are constantly negating upsurges, and are likely to continue to need to do so for some time. But surveillance systems and communication techniques are at least as smart as the perceived “enemy” in the majority of cases, and the population within which they reside are very different to the “hear no evil, see no evil” attitude prevalent during the troubles. In the current developed world local terrorism is considered passé by most observers.

On the unionist side, the Ulster Volunteer Force (UVF) and its myriad of off-shoots, still have not forgiven Paisley for leading them up to the top of the hill in 1986, and then seemingly abandoning them there, when he tried to form the Ulster Resistance. Old sins have long shadows. Many believe that any loyalist reaction to a border poll and its results will be dictated by the loyalists themselves, and not the DUP. They have also stated that they are democrats first and foremost and will abide by the decisions of the ballot box.

The days ahead are fascinating, but I do not think there is a great appetite for the preservation of the Union in mainland Britain. The Republic of Ireland still has some convincing arguments but have history pushing them strongly. The EU is unlikely to be found wanting when called.

The Irish border's days are likely to be numbered, unless, and this is very possible, Sinn Féin blows it by constantly playing to their core constituency and antagonising the “56%” middle ground.



Viewpoint from Edinburgh

Photo: John Cooke



Scotland's Take on Brexit

John Cooke

If the UK's contortions over Brexit were portrayed in art form, something by Hieronymus Bosch might provide a useful model.

At the time of writing, British MPs have voted twice (possibly more by the time you read this) to reject the deal that Theresa May's Government agreed with the EU last November; they have also voted not to leave the EU without any deal; and to ask the EU for a delay to the UK leaving the EU under 'Article 50'. And while all these votes were 'meaningful', none is legally binding. Meanwhile, the UK's proposals for tariffs in the event of a no-deal Brexit would likely breach WTO rules, according to Phil Hogan, the EU's Agriculture and Rural Development Commissioner.

So, what does Scotland – where 62% of voters opted to remain within the EU – make of all this?

Her universities, and her life sciences and digital industries, all of which are instinctively international in outlook, were never keen on leaving.

The agricultural sector was more divided, but relies heavily on seasonal workers from the EU. Scotland's farmers say that the number of visas for such workers in a proposed UK-wide scheme isn't enough. That could see soft fruit rotting in the fields for lack of anyone to pick it.

Scotch Whisky, as well as being Scotland's national drink, has an export value of around £4.7Bn per annum. Without it, the UK's trade deficit would be 3% worse than it is. Brexit could threaten that, as the protection given to Scotch in some countries is the result of agreements negotiated by the EU.

People in the oil and gas industry seem more relaxed: Brexit is just one more uncertainty among many. However, some worry about delays in the supply chain for equipment used on offshore platforms or in subsea vehicles, while EU nationals comprise about 7% of its workforce. And independent academic research calculates that Aberdeen, the 'oil capital of Europe', would see the largest reduction in output, measured by gross value added, of any UK city as a result of Brexit.

Scotland's east coast fishermen – no fans of the Common Fisheries Policy (CFP) – were vociferous for leaving the EU. But Scotland's fish processors, who account for nearly half the UK industry, saw how Norway's industry declined because of EU tariffs, and fear a similar fate if they don't have full access to EU markets.

The case of 87 year-old grandmother, Tove MacDonald, has highlighted the plight of EU citizens in Scotland, which seems more open to free movement of people than other parts of the UK. Born in Copenhagen, Mrs MacDonald moved to Scotland in 1960, married a Scotsman, and has been here ever since. She tearfully told reporters how she couldn't understand why the UK Home Office – not known as a beacon of compassion - had told her to register to stay in the land that's been her home for 59 years.

What all this means for Scotland's political landscape remains to be seen, especially on the question of independence, which is the major fault-line in Scottish politics.

Independence supporters point to how 26 other member states have stood solidly with Ireland – with less than one percent of the total EU population – in the negotiations, contrasting this with what they see as Theresa May's 'dismissive' attitude to Scotland. They also highlight that in the European Union, a single, small member state can veto a policy it does not like – the extension to Article 50, for example; whereas in the UK Union, Scotland has no such veto over UK policy that would damage its interests.

Whether they will be able to persuade those who opted to stay in the UK in 2014, but to remain in the EU in 2016, to vote for independence now, is far from certain. Some have made that journey, but equally, some who voted to leave the UK in 2014, also voted to leave the EU. And those against independence claim the difficulty in negotiating Brexit shows the difficulty in disentangling political unions.

The Danish physicist, Niels Bohr, once said, "prediction is difficult, especially about the future". That's true of many things, but particularly of Brexit.

Photo: Pixabay



A Ticking Bomb?

Chinese Immigration to Russia's Far East

Eugene Kogan

Chinese immigration to the Russian Far East and the debate about its advantages and disadvantages began in Russia in the early 1990s after the collapse of the Soviet Union. The idea of Chinese immigrants being a ticking bomb has been disseminated by Russian officials for years.

Ultimately, the bomb did not go off or harm the Russians living in the region. Nevertheless, Russian media propagated an image of Chinese immigrants invading the Russian Far East quietly and depriving the Russians of their jobs, thus posing an immediate threat. Also this immediate threat did not materialise. After all, China's population is ageing rapidly, and China itself will soon face labour shortages. As a result of domestic political changes in China, the number of Chinese workers seeking work in Russia is declining. Therefore, the myth of hordes of Chinese taking over the Russian Far East was precisely that; but it lives on among the Russians in the Far East.

The Russian Far East (RFE) is a very important region for three important production sites of the Russian military aviation industry. These are the Komsomolsk-on-Amur Aircraft Plant (KNAAPO), manufacturer of fighter aircraft Su-27/30/35, the Ulan-Ude Aviation Plant (UUAP), manufacturer of Su-25 fighter aircraft, and the Progress production site in the Primorsky region, manufacturer of military and civil helicopters from Kamov. In addition, the Russian Eastern Military District (MD) headquartered in Khabarovsk and the Pacific Fleet headquartered in Vladivostok remain important elements to fend off any attack from the East. Therefore, President Vladimir Putin's government is carefully monitoring Chinese immigration to the Russian Far East, and if necessary would restrict or expel Chinese immigrants. For example, in 2006, 100,000 Chinese merchants were forced to leave Russia, and the Russian Far East suffered serious consequences. Such an act can be repeated at any time despite improved bilateral Russian-Chinese relations; Russia's domestic considerations outweigh its external relations.

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A Peaceful Invasion?

Chinese immigration to the Far East of Russia is not a recent phenomenon, and government officials have previously distorted the growth of the Chinese population in Russia, reinforcing the feeling that a silent invasion is under way. In July 1999, Viktor Izhaev, former governor of the Khabarovsk region and former representative of the President of the Russian Far East, made an alarming state-

Resettlement Programmes

In order to stop the shrinking of the Russian population in Siberia, President Vladimir Putin launched a state programme in June 2006 to encourage Russian compatriots living abroad to voluntarily resettle to the Far East. The programme aimed primarily at ethnic Russians, people who now frequently live as second-class citizens in the former Soviet republics. But the programme has



Photo: ESD Archive

The Russian border gate near Manzhouli, China

ment: "The entire country in the Russian Far East will be bought by Chinese. A peaceful occupation of the Far East is under way" and it would only be a matter of time before the Chinese would seek the return of what they consider their historical territory. Such perceptions were later reinforced by President Vladimir Putin; during a visit to the border town of Blagoveshchensk in July 2000, Putin told the inhabitants: "If you do nothing to change the economic development of the region, your children will speak Chinese". This kind of rhetoric is not new, and little has been done to dispel the fears of the population. In the last three decades, only a few Chinese immigrants have invaded the Russian Far East, but they mostly stayed in the region for a short time or used the region as a transit point on their way to Central Asia.

been tacitly abandoned as the government has recognised the plan as unfeasible. That should come as no surprise. Russian migrants returning to Russia prefer to settle in the more developed areas rather than in the Far East, and the meagre financial incentives offered by the Russian Government do not tempt Russian migrants.

One Hectare for Free

The latest "Strategy for the Economic and Social Development of the Far East and Lake Baikal Region", signed by Putin in December 2009, says nothing about increasing the population with new settlers, but focuses on encouraging existing Russian residents to stay in the region by "creating comfortable living conditions" and "reach-



Photo: Alex1979

Decrepit industrial facilities dominate the city of Amursk in Russia's Far East. More than 1.2 million Russians have left the region since the collapse of the Soviet Union.

ing the average level of social and economic development in Russia". But even this goal was not achieved, and the Russians continue to leave the Far East. Moscow has also sponsored the so-called "Far Eastern Hectare" immigration promotion programme, but according to a November 2016 survey by the Russian Public Opinion Research Centre (VTsIOM), only 14% of Russians and 27% of people living in the Far East would even consider applying for one hectare of land in the Russian Far East under this programme.

According to official statistics, the population in the Russian Far East decreased by 1.75 million (out of 8 million) between 1990 and 2010. Whether or not the shrinking Russian population in the Far East can be supplemented by Chinese immigrants is uncertain, but President Putin's government sees the issue as a threat to national security rather than an opportunity for the country's economy.

Moreover, the Russian perception of Chinese immigrants as a yellow danger is deeply rooted in the Russian psyche. To be on the safe side, Russia accepts Chinese immigrants as temporary workers, but they do not want them to settle in the RFE in the long term. Such a policy is no incentive for the Chinese to emigrate to Russia, and Russian perceptions are unlikely to change in the foreseeable future.

Today, the 6.3 million inhabitants of the Russian Far East face 110 million Chinese in the three provinces of Manchuria on the other side of the once porous border.

The Russian leadership and analysts have pointed to this demographic imbalance and the often exaggerated figures of illegal Chinese migration to highlight the vulnerability of Russia's Far East. However, the Russian programmes mentioned above are not good enough to overcome vulnerability, and the incentives associated with the Russian programmes do

Photo: Facebook



The Kremlin's plans to lease more than 100,000 hectares of land for 49 years to a Chinese company triggered a nationalist uproar in Russia. A meme circulating widely in social networks shows Putin and a Chinese. The caption reads: "Krim is ours, Siberia is yours!"

not lead to the migration of Russians to the Far East. At the same time, since 2015, immigrants have had to take a comprehensive examination to test their knowledge of the Russian language, history and relevant laws before they can apply for the necessary permits and documents. Shortly after the introduction of the comprehensive test, China asked Russia to abolish the Russian language test for Chinese guest workers, but this request was rejected. As a result, Chinese immigrants were unable to stay in the region.

To counter allegations of Chinese extraction of raw materials at Russia's expense in the Far East, Russia and China signed a Memorandum of Understanding (MoU) in early 2016 to relocate Chinese companies to the Far East in twelve key sectors, including agriculture, energy, engineering, metallurgy, shipbuilding, textiles and telecommunications. At least theoretically, Chinese companies should want to relocate to the Russian Far East because of China's overproduction, access to the Russian market and its growth potential, as well as the region's natural resources, less stringent environmental regulation and lower overheads due to the devaluation of the rouble. Chinese factories could in turn create new employment opportunities for the region.

A Chinese Takeover

For instance, the Ministry for Development of the Russian Far East (Minvostokrazvitiya) reported on 29 November 2017 that Russia's Far East Investment and Export Agency and China's Paper Corporation, a division of China Chengtong Holdings, signed an MoU on the implementation of a project to build a pulp-and-paper mill in the city of Amursk in the Khabarovsk region. The mill will produce up to 500,000 tonnes of pulp per year; overall investment in the project will total about US\$1.5Bn. No progress in the implementation of the project has been reported since the MoU was signed. Therefore, the cross-border transfer of Chinese companies remains limited and is not expected to increase in the coming years.

In Russia, many of these initiatives have met with resistance at the local level. Although sometimes misinformed, such an opposition shows the different perspectives between federal and local governments regarding China's role in the Russian Far East. In mid-2015, for example, major demonstrations took place in the Baikal region against the lease of more than 100,000 hectares of land for 49 years to Hia'e Xingbang, a private Chinese company, for US\$440M. The plan was not implemented. These concerns result in part from the "farm rush" of the 1990s and early 2000s, when farm workers from China moved to the fertile land in the Far East along the border.

Some Russians have pointed to this migration flow as evidence of a Chinese takeover of the Russian Far East. In reality, land under cultivation in the region declined by about 60% between 1990 and 2006, while Chinese farms have been commercially motivated, primarily producing crops for the Russian market.

To dispel these fears, Alexander Galushka, Minister for Development of the Russian Far East, has repeatedly emphasised that the "Russian workers are priority and then foreigners who will not have problems with adaptation; those who know the Russian language, and are close to us in history and culture."

Galushka stressed that the framework agreement with China on the establishment of the Russian-Chinese Agrofund provided that at least 80% of employees in joint projects must be Russians. Nevertheless, the Russians fear that the growing Chinese presence will facilitate China's economic dominance in the Russian Far East at the expense of foreign competitors and Russian companies. To address these concerns, the Ministry of Development of the Far East of Russia has stated that Russian contractors and suppliers will be given priority in these companies. The locals have also expressed concern about the pollution caused by the relocation of Chinese dirty industries to Russia. All these concerns have contributed to more bureaucratic hurdles being imposed on the Russian side. Moreover, local officials do not view the implementation of these projects with the same expediency, as these value-adding

companies do not provide immediate payoffs to local officials compared to natural resource extraction. Therefore, the economic factor outweighs the human factor, and Russian bureaucratic hurdles hamper Chinese investments.

The arguments against lifting the visa requirement are even more speculative. Some fear that visa-free travel could lead to uncontrolled immigration; alarmists say that an influx of Chinese could lead to ethnic crime, environmental disasters and even the secession of the Far East from Russia. It remains unclear on what basis the scaremongers are making their allegations, but for now the scaremongers have the upper hand and the lifting of the visa requirement for Chinese is not on the agenda.

After all, geopolitics has always been a fundamental concern of the central government in its dealings with the Far East. Because of the region's remoteness from the centre of the country, its sparse population, poor transport infrastructure and the presence of large and ambitious powers in its neighbourhood, Moscow must always be very careful when it comes to the Far East's external relations. And Moscow manages external relations with great care, maintaining balance with its neighbours and keeping Chinese immigrants on a leash.

Conclusion

In summary, it can be said that Chinese immigration is certainly not a ticking bomb, but a rather exaggerated perception of threat that both Russian officials and Russian people living in the Far East are unwilling to overcome. There is also agreement in Russia that Russians living in the Far East tolerate the presence of Chinese immigrants as long as the West maintains economic sanctions against Russia. As soon as the West no longer sanctions Russia, Russian tolerance will turn into intolerance and the threat from China will be re-emphasised. However, there is an additional factor that the Russian authorities can no longer ignore. China's population is ageing rapidly. This means that, given the labour shortage in China and rising wages, the willingness of Chinese workers to seek work in Russia is likely to decrease in the coming years. This would have a negative impact on the local Russian population, which will decline in the foreseeable future. The shortage of skilled labour in the region will remain a major problem for some time to come. As a result, both local residents and Chinese immigrants are in a vicious circle that the Putin government cannot or may not want to solve. ■



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The Policy of the United States in the South Caucasus

Gayane Novikova

What does the new foreign policy under Donald Trump mean for the complex security environment?

This article analyses the interaction between the three main actors of the South Caucasus region, Armenia, Azerbaijan and Georgia, through the prism of change and continuity in US regional policy.

Any discussion regarding the current state of US foreign policy contains more questions than answers. The more recent trend has been determined by the slogan "America First!", which means on the one hand that the US is moving toward a more isolationistic policy. Steps which aim to serve only American interests can be to

some extent provocative and unpredictable: In many cases they can give an impulse to irreversible changes in the security environment in certain regions. On the other hand, there is both a visible and hidden continuity in respect to the main directions and approaches toward the core issues of the American foreign policy.

environment to the extent that global peace and security is affected.

This article therefore aims to analyse the frameworks of interaction between the United States and the three main stakeholders of the South Caucasus region: Armenia, Azerbaijan, and Georgia, through the prism of change and continuity in US regional policy.

Photo: US State Department



US Secretary of State John Kerry shakes hands with Armenian President Serzh Sargsyan on 16 May 2016 at the Bristol Hotel in Vienna, Austria, before US, Russian, and French officials sat down with Armenian and Azerbaijani leaders in an effort to calm tensions over the disputed Nagorno-Karabakh region.

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Changes and continuity in US foreign policy can be found not only in regard to global issues. The dynamic of developments even in areas of the world peripheral for the US or – at first glance – around "insignificant" or less important issues can provoke the collapse of a very fragile regional security en-

The US National Security Strategy

The Trump administration introduced its National Security Strategy (NSS) in December 2017. It states that the "America First foreign policy celebrates America's influence in the world as a positive force that can help set the conditions for peace, prosperity, and the development of successful societies." To analyse the exact results of this influence upon the other states, which are both US partners and rivals, it is necessary to note that the foreign policy of Donald Trump possesses several distinctive aspects in comparison with the foreign policy of his predecessor Barack Obama. Within the context of this article, the most important are the approaches to international peace and security and the role of global actors in preserving stability and promoting democracy. In the NSSs of both presidents, the global threats to US security have been Russian, Chinese, and Iranian ambitions, as well as international terrorism and crime.

The main difference lies in their approaches to the avenues to eliminate these threats. President Obama introduced "strategic patience" in interactions with other actors and emphasised that the "rules-based international order advanced by US leadership [...] promotes peace, security, and opportunity through stronger cooperation to meet global challenges." President Trump, who views for-

eign policy per se as his personal domain (which means that it can be – to a certain degree – unpredictable and impulsive), conversely demonstrates "strategic impatience", as he attempts to shape the international order in accordance with his vision of how to protect US sovereignty: "My Administration's National Security Strategy lays out a strategic vision for protecting the American people and preserving our way of life, promoting our prosperity, preserving peace through strength, and advancing American influence in the world. [...] we will serve the American people and uphold their right to a government that prioritises their security, their prosperity, and their interests. This National Security Strategy puts America First." According to the NSS, "The United States will respond to the growing political, economic, and military competitions we face around the world... These competitions require the United States to rethink the policies of the past two decades – policies based on the assumption that engagement with rivals and their inclusion in international institutions and global commerce would turn them into benign actors and trustworthy partners. For the most part, this premise turned out to be false." Therefore, it is correct to evaluate the current version of the NSS as based not on cooperation but on competition. Although the South Caucasus region was not mentioned in the 2017 NSS, some features mark a trend toward a multilayer involvement of the US into processes in this area. In the preamble to the NSS's chapter "The Strategy in the Regional Context," it was stated that the US "must tailor [its] approaches to different regions of the world to protect US national interests. We require integrated regional strategies that appreciate the nature and magnitude of threats, the intensity of competitions, and the promise of available opportunities, all in the context of local political, economic, social, and historical realities."

The long-term strategic interests of the US toward the South Caucasus region can be identified by – among others – two important factors: its location and fragile security environment.

Geopolitical Competition

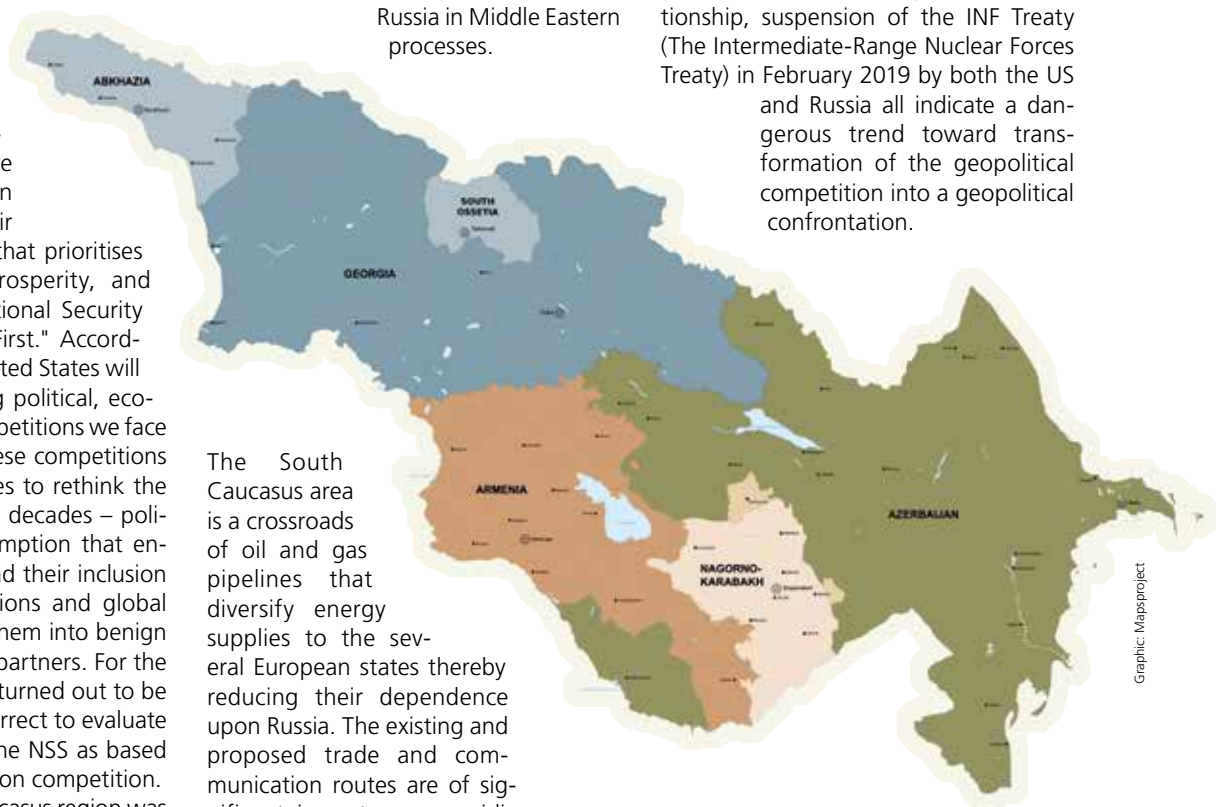
The South Caucasus region can be considered as a constituent part of larger regions, in particular the Broader Middle

East. From the US perspective, it accomplishes at least three important functions. First, as a buffer zone, the South Caucasus reduces the scale of penetration of a broad spectrum of security threats (including Islamic radicalism, terrorism, drug- and human trafficking, and uncontrolled migration) emanating from the vulnerable Middle East. Second, in part it can be viewed as an obstacle against a more active inclusion of Russia in Middle Eastern processes.

The South Caucasus area is a crossroads of oil and gas pipelines that diversify energy supplies to the several European states thereby reducing their dependence upon Russia. The existing and proposed trade and communication routes are of significant importance, providing transport corridors which connect the Central Asian states and China to Europe. This region is essential for China's "Belt and Road" initiative. The geopolitical competition with the inclusion of Armenia, Azerbaijan, and Georgia, can be analysed in a three-level overlapping and mutually influential framework. At its first level are Armenia, Azerbaijan, and Georgia, which have very complicated relationships with each other. Numerous regional contradictions have shaped the Georgian-Azerbaijani strategic partnership, the Armenian-Georgian friendly relations and the Armenian-Azerbaijani enmity. These states also either border with, or are in close proximity to, three regional powers: Russia, Iran, and Turkey. These powers constitute the second level of actors directly involved in South Caucasus processes. The strategic interests of Russia, Iran, and Turkey, as well as their models of interaction with each other, allow them to manipulate the South Caucasus states

and significantly to limit the space available to them for political, economic, and military manoeuvring.

Insertion of the US into this scheme as a third-level supra-regional actor brings even more intricacy and complexity into relations on the ground. The US sanctions against Russia, its withdrawal from the Joint Comprehensive Plan of Action ("Iran Deal") in May 2018, the growing tension in the US-Turkey bilateral relationship, suspension of the INF Treaty (The Intermediate-Range Nuclear Forces Treaty) in February 2019 by both the US and Russia all indicate a dangerous trend toward transformation of the geopolitical competition into a geopolitical confrontation.



The increasing US involvement in South Caucasus affairs aims: a) to limit Russia's presence in the region; b) to restrict Iran and to control the interactions of Armenia, Azerbaijan, and (to a lesser extent) Georgia, with Iran, and c) to promote mutual interests in the Middle East with Turkey as a strategic partner and ally. In the meantime, an intensifying tension between the regional powers and the US will cause a further deterioration of security in the South Caucasus.

Regional Conflicts

Another set of factors which determines the strategic interest of the US toward the South Caucasus states is related to the three unresolved conflicts of this area. Developments in and around each of these conflicts can pose a serious security threat: Under certain conditions, a small war can transform into a regional one that involves the participation of several regional actors.

In the Abkhazian and South Ossetian conflicts, the United States is actually excluded as a player. After the outbreak of the Russian-Georgian war in August 2008, the EU (France and its President Nicolas Sarkozy, in particular) took the initiative to negotiate a six-point peace plan to end the war and to find a political solution. However, the signed Medvedev-Sarkozy agreement was factually annulled after recognition of Abkhazian and South Ossetian independence by Russia in September 2008. Consequently, these two conflicts have been transformed from internal ethno-political conflicts into international ones. Antagonistic Russian-Georgian relations still prevent an implementation of any model of reconciliation between Georgia and the two breakaway semi-recognised statelets, at least in the foreseeable future. The US currently lacks a comprehensive policy in these "Georgian conflicts": It has withdrawn from any discussions and limited itself to statements that support Georgia's territorial integrity. There is no sign that the US has any desire to be directly involved in the resolution of the Abkhazian and South Ossetian conflicts. It must be noted that the discussions around the Georgian conflicts have intensified since the annexation of Crimea by Russia in 2014. In July 2016, the US and Geor-

Georgia's reliance and its resilience and its self-defence capabilities." Later, in the US NSS (2017) the only reference to the South Caucasus was related to Georgia: "With its invasions of Georgia and Ukraine, Russia demonstrated its willingness to violate the sovereignty of states in the region."

Another statement, indirectly concerned with the "Georgian conflicts", appeared in September 2018. Assistant Secretary of State for European and Eurasian Affairs, A. Wess Mitchell, addressing the 2018 Tbilisi International Conference, stressed that "together with the weapons and training that we provide, [our bilateral relations] demonstrate very clearly that the US will commit the resources and the attention to supporting Georgia and to making sure that Georgia is able to defend its territory. First and foremost, the territorial integrity, sovereignty, and independence of Georgia have been and remain at the heart of the United States strategic objectives in the Caucasus."

The Nagorniy Karabakh Conflict

A different approach can be observed in the US involvement as a mediator in the Nagorniy Karabakh (NK) conflict. Currently the OSCE Minsk Group (MG) platform (established as a framework for the mediation for settlement of the NK conflict) remains probably the only

to negotiate a solution based upon a mutual compromise (namely, the so-called Madrid Principles, as updated in 2009). The outbreak of the conflict in April 2016 clearly demonstrated the growing danger to regional peace and security.

The parties to the conflict directly and indirectly have been blaming the mediators for their inability to suggest something critically new regarding principles for a resolution. Meanwhile, in the course of the last ten years, the co-chairs of the OSCE Minsk Group have attempted to give a new impulse to the negotiations. In particular, the former US Co-Chair, Ambassador Richard Hoagland, recognised: "There are several unresolved, protracted conflicts on the territory of the former Soviet Union, and each one is somewhat different. ...you have to look at exactly what are the elements involved in that conflict... In fact, I'd go so far as to say maybe this [the NK conflict] is just an example of good diplomacy and what I would call Realpolitik." Furthermore, his statement that "there can be no settlement without respect for Azerbaijan's sovereignty and the recognition that sovereignty over these [surrounding Nagorniy Karabakh] territories must be restored" provoked intensive discussions between the parties to the conflict on whether he intentionally avoided mentioning Azerbaijan's territorial integrity and this is a sign of a new policy by the US and /or the Minsk Group, or he simply modified this term slightly.

There are some signs of the US readiness to play a more active role and to speed the NK conflict resolution. A visit by US National Security Advisor John Bolton to the region in October 2018, and his press conferences in Baku and Yerevan, indicated that the US is in favour of a compromise that will bring both Azerbaijan (as a US strategic partner) and Armenia (the relations with which he described as "a top priority") closer to the West, and thereby to reduce Russia's influence in the region. He said, "From Armenia's point of view, the surest way to reduce excessive outside influence in Armenia is to reach a resolution on Nagorno-Karabakh." Advisor Bolton also discussed arms purchases, stressing that purchasing of weapons from Russia "has clearly not contributed to a resolution of the dispute, because of the enormous leverage it gives Russia over both parties...We [Americans] believe in competition as a spur to improvement, and our military equipment is better than the Russians' in all cases. This is something we should consider." This offer to sell weapons to the parties to the NK conflict should be viewed not only through the

Photo: OSCE



On 26 May 2016, the OSCE PA Special Representative on the South Caucasus Kristian Vigenin visited the boundary line separating South Ossetia from Georgia near the village Khurvaleti.

gia signed a new agreement that shifted military assistance to Georgia from the training of its troops for international deployment to an increase of its self-defence capabilities. As John Kerry, the former US Secretary of State, mentioned, this agreement "defines our security partnership and the steps we will take together to further

area of US-Russia cooperation, in spite of existing differences. As a co-chair of the MG, the US, together with Russia and France, is trying to facilitate a consensus between the parties to the conflict, namely Armenia, the Republic of Artsakh (also known as the Nagorno-Karabakh Republic), and Azerbaijan, and

prism of the US–Russia relationships and the desire of the US to contain Iran, but also be evaluated as a step toward further escalation of an arms race in the already heavily militarised area. Given the situation where the NK conflict is still very far from resolution, any violation of balance of powers can be extremely dangerous. Several direct and indirect factors influence the US position regarding resolution of the Nagorniy Karabakh conflict. Among them should be mentioned the following:

- Azerbaijan has been viewed by US authorities as a secular Muslim state that can (together with Turkey) be helpful in the fight against global Islamist terrorism;
- Azerbaijan allows use of its air and sea ports as essential transit points for US and NATO troops, supporting their missions in Afghanistan;
- Azerbaijan is a key actor in regard to energy supplies to several European states;
- In 2018 alone, the US invested US\$13Bn in Azerbaijan's economy, including more than US\$1Bn in the country's non-oil sector;
- The efforts of the Armenian lobby, which is focused on Armenian Genocide recognition and on maintaining US direct economic support to Armenia and the Republic of Artsakh, and on recognition of Artsakh's independence by various states in the USA, are limited by the united efforts of Turkish and a growing number of Azerbaijani lobbyists.

Concluding Remarks

In conclusion, the US strategic interests toward the South Caucasus as a region is

growing owing to the location of this area: it stands at a crossroads where the interests of three core actors – Russia, Turkey, and Iran – coincide, overlap, or confront each other. Depending upon geopolitical developments, the US can find itself facing an increasing joint resistance of these states toward its policies in the Broader Middle East and in the South Caucasus in particular.

Moreover, the critical goal of the US as concerns the interaction with the three regional states – Armenia, Azerbaijan, and Georgia – involves their more active engagement and larger participation in providing and securing US strategic political-military and economic interests in the area of dominant Russian, Turkish, and Iranian presence and influence. In regard to the growing security deficit in different parts of the world, and especially in the South Caucasus, the following statement in the US NSS should be considered seriously: "We will compete with all tools of national power to ensure that regions of the world are not dominated by one power."

A promotion of democratic values as the US global mission is currently not on the US agenda. In contrast to President Obama's National Security Strategy, which stated that "defending democracy and human rights is related to every enduring national interest", the Trump administration in its first NSS made it clear that it is "not going to impose our values on others." This position echoed quite clearly the US attitude toward the South Caucasus states: the security agenda is prioritised over democratic values and human rights. At the press conference in Yerevan, the US National Security Advisor John Bolton was asked about Washington's reaction to the Armenian

Velvet Revolution. His answer did not refer to the peaceful change of power, an improvement of the human rights situation, or progress in the fight against corruption. Instead, he stressed that, after the parliamentary elections in a December 2018, "the most opportune moment [will have come] to take strong action in number of different respects... There is no better time to try and take decisive action [in the resolution of the NK conflict]." In Baku, Bolton's answer to a question about an "unrelenting crackdown on civil society and independent media in Azerbaijan", was a quote from President Trump's speech at the UN GA; to him, the US has "a desire not to lecture other countries".

Although the threats and challenges emanating from the wider Middle East are common to all the above-mentioned states, the possibility of a broad cooperation to prevent or minimise them is quite low; a shared strategic vision has been replaced by Realpolitik.

Finally, the South Caucasus states are already involved in a vicious circle of intensifying and expanding geopolitical competition. Against a background of a growing confrontation between the US and Russia, an increasing hostility between the US and Iran, and an ambivalent US–Turkey relationship, three South Caucasus states have a special task: To find for themselves an acceptable modus operandi with all these external actors and to avoid by all means a further increase in regional security deficit. Reaching this goal will be difficult under the present circumstances: Existing regional bilateral and multilateral problems have become instrumentalised amidst the geopolitical games of others. ■

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A Question of Balance

The Netherlands between Atlanticism and European Army

Thomas Bauer

In a speech at the University of Zurich in February this year, Dutch Prime Minister Mark Rutte called for a declaration of commitment by Europe to more “Realpolitik”. This rallying cry revealed a fundamental dilemma in the security and defence policy of many European states, and above all of the Netherlands. The crisis in transatlantic relationships is perceived by many as an opportunity for developing a new self-awareness in Europe in terms of security policy. A difficult balancing act, which could be orchestrated by the Netherlands in particular.

This has to do not only with the rumours that the Dutch Premier wanted, by way of the speech, to move into a lead position within Europe, rumours which Mark Rutte himself rapidly dispelled. Rather, the Netherlands represent a group of states in the European Union which not only advocate every European initiative towards develop-

drives and developments always take place in the sense and spirit of the transatlantic Alliance and NATO. This is where the differences come to light in comparison with the aspirations of French President Macron, who with his plans for a European Army wants to achieve a clearly more independent stance by Europe in relation to the USA,

Two-Pillars Approach

The Netherlands have for many years been supporters of a stronger European cooperation with respect to a common security and defence policy. The basis for this is also the membership of NATO, which the Netherlands have belonged to since it was founded in 1949. The experiences from the first half of the 20th century led The Hague to the realisation that the protection and guarantee of national sovereignty of the Netherlands can only be assured by a lasting commitment by a power outside Europe to the security of Europe itself. The loyalty of the Netherlands to NATO came under enormous pressure during the peace movements of the late 1970s. Confronted with a massive opposition against nuclear weapons, the government under Minister President Ruud Lubbers in the 1980s pursued a seesaw policy supporting the NATO double-track decision on the one hand and at the same time insisting on independent Dutch decisions against the possible stationing of American warheads. The agreement concluded between Washington and Moscow in 1987 to do away with all nuclear intermediate-range missiles (INF treaty), brought this balancing act to an end. Besides NATO membership, all the governments in The Hague after Second World War have also supported moves towards a far-reaching European integration. The guideline concept in this context was the conviction that the smaller European countries would only be able to prevent the dominance of the big States like France or Germany by taking part in the integration process. This consideration also resulted in the clear preference at The Hague for supranational efforts, in other words initiatives, which lead to the transfer of national powers to European institutions.

Photo: European Parliament



Dutch PM Mark Rutte addressing a plenary session of the European Parliament in Strasbourg

ing security and defence policy capacities and capabilities, but also support this by appropriate measures and by a great deal of commitment. At the same time, however, it is important to The Hague that these

but also on the part of NATO. In his speech in Zurich, the Dutch Premier accordingly emphasised the need for Europe, in matters of a stronger military commitment, not to hide any longer behind a perceived sense of moral superiority, while at the same time enjoying the security of the protective shield offered by the USA. The European Union should be “less naive and more realistic” about its foreign policy and not be afraid to exercise power, Mark Rutte said in his speech.

Author

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Photo: defensie.nl

Humanitarian aid conducted by Dutch troops on the Caribbean island Sint Maarten after a hurricane disaster in September 2017

Conversely, the plans by French President de Gaulle or German Chancellor Konrad Adenauer for the crafting of a European Political Union, or even a European defence association outside NATO, were categorically rejected by the Netherlands. Even with the end of the Cold War, all the governments at The Hague adhered to

the clear orientation of Dutch security and defence policy towards the transatlantic Alliance. At the same time, the change in the international security structure and the shift from a bipolar to a multipolar world called for a new positioning of Europe, and therefore also of the Netherlands. The conflicts in the Near and Middle East, the Af-

ghanistan and Iraq wars, the terror attacks of 11 September 2001, and the rise of new regional powers such as China induced a "pivot to Asia" proclaimed by the former Barack Obama administration. The protection and maintaining of the security of Europe would in future have to be ensured by the Europeans' own initiatives towards establishing robust capabilities and capacities. Developing a European Security and Defence Policy (ESDP) and all the aspects associated with this, such as the European Security Strategy (ESS), the European Headline Goal (EHG), or the system of the European Battlegroups, therefore found approval in The Hague only on the premise that the new European security and defence dimension would always have to be viewed in the context of maintaining and strengthening the transatlantic Alliance.

In November 2017 the Netherlands were among the first countries to express support for a close security policy cooperation within the framework of the EU, by participation in the Permanent Structured Cooperation arrangement (PESCO). The first PESCO flagship project with the aim of expanding military mobility is actually under Dutch leadership. Military mobility aims at improving arrangements, laws, regula-

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tions and infrastructure in order to speed up the movement of military equipment throughout Europe. It requires a tremendous amount of European decisions and actions, but it primarily serves NATO reinforcements for Article 5 contingencies. The support of the Netherlands towards strengthening the European security dimension is therefore always to be understood as strengthening the European column within the transatlantic partnership, not as a substitute for it.

In the light of the ambiguous attitudes of the Trump administration towards NATO it is important for the Netherlands to find the right balance between the pro-European initiatives of the past few months and the attempts to revive the transatlantic security and defence framework. The central aim for The Hague must therefore be to avoid an either/or between Atlanticism and Europe. It is for this reason that Mark Rutte is currently coming out against the plans for developing a European Army. "NATO remains our first line of defence and our guarantee of security, and in my opinion that rules out a European army," he said.

New Strategic Focus

In May 2018 a new strategy paper was published in The Hague which sketches the path for Dutch security and defence policy up to 2022, the Integrated International Security Strategy 2018-2022 (IISS). The document outlines the strategic framework within which the Netherlands will move in future. The three core elements of the IISS are "prevent", "defend" and "strengthen". The IISS casts light on the broad spectrum of different challenges and threats. If the six threats which are given closer scrutiny are subdivided into blocks, the changes in the security picture which have occurred in the last 30 years can be clearly read. Block One comprises the classic threats from conventional military forces and weapons of mass destruction. If, at the end of the Cold War, there had still been hope in Europe of being spared these threats in future, it has been dashed by the increasing tensions and risks in the region brought about by the Ukraine conflict, the dispute between NATO and Russia regarding the stationing of intermediate range missiles, and the failing of the great disarmament treaties. Block Two is circumscribed by terrorist strikes and cyber attacks, which have dominated the threat scenarios for the last two decades. All attempts made since 11 September 2001 to bring this danger under control by military and non-military measures have contributed little to global security. Deteriorating state structures are still prolific on every continent in the world, and accordingly offer adequate space for terrorist groups to withdraw, recruit, and proliferate. The third group, with terms such as "Undesirable foreign interference and disruption" and "Threats to vital economic processes" introduces two more recent threat scenarios, the investigation and assessment of which in respect of influence and scope are still a work in progress.

In all, thirteen aims are defined in the three columns with which the security of the Netherlands, but also for Europe and the rest of the world are supposed to be guaranteed. In the Prevention section, the aims to be found are: (1) Preventing conflict around Europe and the Kingdom, (2) Eliminating the root causes of terrorism, (3) Disarmament, arms control and non-proliferation of weapons of mass destruction and (4) Clear international norms for cyber activities. In the Defend section, the aims defined are: (5) Modern collective self-defence and protection of Dutch and NATO territory, (6) Forceful cyber deterrence, (7) Counterterrorism, (8) Societal resilience to foreign interference, as well as (9) Safeguarding economic security and (10) Tackling cross-border crime.



Finally, the last column, Strengthen, harbours the aims of (11) Promoting the international legal order, (12) Strengthening international security cooperation, and (13) Robust and balanced integrated border management and control.

This very broad initial analysis illustrates that on the one hand it addresses the complexity of the current security policy theme issues and threats, but at the same time also pinpoints the necessity of maintaining multilateral cooperation in order to bring these under control. And this necessity is reduced not only to the classic hard power approaches. Specifically, as well as the military and terrorist challenges, climate change is also causing increasing unease among the security policy strategists in The Hague. Climate changes lead to additional threat scenarios, which in future will result in the more frequent and more widespread commitment of military forces, both at home and abroad. "The threats are real. We already see them. And the threats will grow as the temperature rises," a representative of the Netherlands' Ministry of Defence warned, speaking at a conference on climate change and security. About a thousand Dutch troops, for instance, were called out for a month to provide humanitarian help and security when powerful Hurricane Irma slammed into Sint Maarten, a Caribbean island that is part of the Netherlands, in 2017. With the foreseeable rise in such events in frequency and vehemence, the pressure on the military forces and the associated budget will increase too. "Globally, militaries are going to be more stretched with operations deriving from climate-induced impacts," she said, calling climate change "the single greatest threat to the security, livelihoods and well-being of people of the Pacific". For many nations, threats at home are also growing. The Hague sits three metres (10 feet) below sea level, protected by a system of dikes and pumping stations, said retired General Tom Middendorp, a former Dutch Chief of Defence. Dutch forces already spend about 25 percent of their efforts supporting civil authorities, including by protecting the anti-flood systems, Middendorp said.

Teaming up with France and Germany?

Confronted with the pending departure of London from the EU, the development of antagonistic relationships in Italy, Hungary and Poland towards Brussels, and the pro-European initiatives from Paris and Berlin, Mark Rutte appears to regard as necessary the adoption of a position in Europe which

is both a wake-up call and a sharp thrust. In his speech in Zurich the Dutch Minister President stressed the need to take more forceful account of soft and hard power. "Today we live in a multipolar world, in which a growing number of countries and political leaders seem to believe that international relations are a zero-sum game. This means that the EU, which was built on the power of principles, is increasingly being confronted by the principles of power. But I

Brexit, France and Germany will dominate the direction of European defence cooperation even more. Together, they will spend almost €90Bn on defence in 2021 or about half of European defence expenditure after Brexit. The Dutch interests will be best served by closely teaming up with these two leading European powers and not by staying aside and rejecting immediately proposals for a European Army, even if they are vague and provocative."



Photo: Hille Hillinga, Mediacentrum Defensie

Ank Bijleveld, Dutch Minister of Defence, and Admiral Rob Bauer (left), Dutch Chief of Defence, visiting camp Rodsmoen in North Norway during Exercise Trident Juncture in October 2018

seriously doubt whether this, on its own, will make the EU as effective and influential as it could be, as it wants to be, and as it should be in the future," he said. Rutte also mentioned US President Donald Trump's criticism of multilateral organisations, and called on the EU to seize that as an opportunity to reform the UN and the World Trade Organization. At the same time he emphasised that the criticism of the US President with regard to what, from Washington's point of view, amounts to too little outlay on the part of the Europeans for defence and armaments cannot be simply brushed aside. The agreed aim between the NATO partners to attain a ratio of 2% of gross national product on defence expenditure by 2020 is still far off. "We need to stand by this commitment, not only because the Americans have a point when they press for a larger European contribution, but above all because it is in our own interest," said Rutte.

Dick Zandee, Senior Research Fellow at the renowned Clingendael Institute, has argued that The Hague should make more powerful use of its position as a moderator between Atlanticism and Europe: "After

An example of this somewhat pragmatic balancing act is the supplementary agreement by The Hague to the plans for an own EU headquarters. While this idea was defined in the beginning as counterproductive to cooperation within the NATO framework, the considerations towards strengthening the planning and leadership capabilities now in focus are being viewed as an advantage. "The choice for any European country, including the Netherlands, is not between Atlantic or Europe. NATO can no longer function under American dominance as was the case in the past. The US itself calls for more European contributions because China and other rising powers will force Washington to dedicate more defence resources to its military efforts in other parts of the world. Despite the stepped-up efforts in recent years, Europe needs to do more to strengthen NATO's deterrence and defence posture", as Dick Zandee emphasises. Perhaps The Hague, with its "both and" solution will trigger not only discussions in Europe, but also within NATO and the transatlantic relationships. ■

“Europe has to take up its responsibility to secure and defend its citizens.”



Photo: Ministerie van Defensie

Interview with Christoffer Jonker, Director International Affairs and Operations, Ministry of Defence, The Netherlands

to the issue of capability development and in achieving more interoperability between EU armed forces, which are essential when it comes to Europe's capacity to act.

Furthermore the Netherlands believes that a strong role for the Council (including Defence Ministers) and linking internal and external security are essential in making CSDP more effective. The Council should be leading efforts to enable a more effective CSDP and the HR and Commission should facilitate a truly integrated approach. These efforts should also be reflected in the future agenda and format of the meetings of the Council and its preparatory and decision making procedures.

ESD: What is the Dutch point of view towards the "worksharing" of NATO and EU in ensuring security and peace in Europe? Do we need more European "strategic autonomy" or should the focus be primarily be on strengthening the European pillar of a continuing Transatlantic alliance?

Jonker: Given the geopolitical situation the Netherlands does believe that Europe needs the capacity to decide and act with partners wherever possible, but also on its own when and where necessary. In short: Europe has to take up its responsibility to secure and defend its citizens.

Thereby the Netherlands is convinced that addressing today's challenges requires collective responses, and organisations like the EU, NATO and the UN have unique strengths. Combining strengths and comparative advantages is especially necessary knowing that nations have a single set of forces and limited defence budgets. In our view NATO is and should remain the primary actor when it comes to deterrence and collective defence.

The EU's combined civil-military toolbox and the EU's integrated approach in which focus on the internal-external security nexus and the deployment of a broad range of instruments are essential, are to be seen as EU strengths that should be developed further. In this context the Netherlands

believes that the focus should be on the operationalisation of the Stabilisation and Support to Capacity Building scenario within the EU level of ambition.

ESD: What are the PESCO initiatives the Netherlands is currently involved in?

Jonker: The Netherlands currently participates in 9 out of 34 PESCO projects as a project member. These projects are the following:

1. Military mobility
2. Maritime (semi-) Autonomous Systems for Mine Countermeasures (MAS MCM)
3. Network of Logistic Hubs in Europe and Support to Operations
4. European Secure Software defined Radio (ESSOR)
5. Cyber Rapid Response Teams and Mutual Assistance in Cyber Security
6. European Medical Command
7. European Union Training Mission Competence Centre (EU TM CC)
8. Co-basing
9. Integrated Unmanned Ground System (UGS)

Of course, the Netherlands was and is also fully involved in the initiatives concerning the "architecture" of PESCO (e.g. PESCO governance, PESCO commitments, sequencing, third party participation etc.)

ESD: What are the perspectives PESCO and EDF offer for the Dutch defence industry and/or for their partnerships with companies from abroad?

Jonker: Both PESCO and EDF, especially EDF which is focussed on industry, potentially offer significant opportunities for Dutch defence industry (and not just Dutch defence industry) and partnerships with companies abroad. Thereby a footnote is that third party participation in EDF is limited and that third party participation in PESCO is still being negotiated. In general, the Netherlands believes that working together with third parties is crucial. In our view an outward oriented PESCO is needed to make it work. In general working together with strategic partners is in our view necessary to make Europe stronger, realism thus being an important

ESD: What do the Netherlands expect from the recent European CSDP initiatives PESCO, CARD and EDF? What are the (first) lessons learned 15 months after the kick-off?

Jonker: The Netherlands is fully committed to take European defence cooperation to a next level. Given the security situation and the inefficiencies and duplications in the capability programmes of all EU member states, there is an absolute necessity to do so. The Netherlands expects CARD, PESCO and EDF to be of added value in relation to this ambition.

As for the lessons learned the following can be stated: now that the architecture is in place, it is time to implement and yield concrete results, showing a Europe that protects. In this context the Netherlands believes that the EU needs:

- More focus/prioritising in the operationalisation of the defined EU level of ambition, taking into account the EU's unique strengths and that of its strategic partners, especially NATO (also see the answer to question nr. 2).
- A coherent "translation" of priorities into capability development initiatives, to ensure focus and to generate the needed output when it comes to PESCO and EDIDP/EDF projects.
- A more output oriented approach: introducing concrete deliverables and timelines by means of specific FAC conclusions, could be a modus operandi to be applied more broadly in the EU context. This is especially relevant in relation

reason to look for strategic partnerships. Related to the EDF, the Netherlands has recently set up a coordinating body (Interdepartmental Coordinating Group on European Defence Cooperation – ICG EDC) in order to coordinate the national effort regarding EDF. In the ICG EDC the Ministries of Defence, of Economic Affairs and Climate, of Foreign Affairs, of Finance and of General Affairs participate, as well as a representative of the NIDV foundation (representing the Dutch defence and security-related industry). Working closely together with all stakeholders, nationally and internationally, is paramount to make the EDF a success.

ESD: In most NATO and EU countries, the changed security-political situation in Europe has induced governments to allocate additional funds for defence and armament. To what extent and in what way has this trend influenced things in your country?

Jonker: In December last year the Netherlands formulated its National Plan on the Defence Investment Pledge and informed the Dutch Parliament. In the plan it is stated that the Netherlands has reversed the declining trend of the national defence

budget, leading to substantial growth in absolute terms. Between 2013 and 2017, additional budget was added in a series of annual steps, leading to a structural rise of the defence budget of €929M in 2017. Planned cuts have been halted and several areas of shortfall have been addressed. In 2018 new measures were taken to expand the defence budget further, with up to €1.5Bn per year. Because of these investments, the Dutch defence budget has grown with more than 25% since 2013. Furthermore a Military Investment Fund for

the purchase and maintenance (including midlife update) of major equipment has been set up. This fund allows for making long term commitments, thereby making the investment budget more robust and future-proof.

Going forward, the Netherlands will continue its step-by-step efforts to keep an upward trend in its defence spending outlook.

The interview was conducted by Peter Bossdorf.



The European Council adopted an updated list of projects to be undertaken under PESCO on 19 November 2018. It included 17 new projects in addition to the initial 17 projects agreed on in December 2017 and formally adopted on 6 March 2018.

Photo: EU

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Increasing Investment in Defence

Procurement Overview: The Netherlands

Edward Hobbs

On a strictly nominal basis, the Netherlands is one of the biggest investors in defence among the dual NATO-EU nations. Yet despite a willingness to invest in its armed forces, the Netherlands does not prioritise the defence budget at the expense of other areas.

This is evidenced by its annual level of spending in proportion to national wealth which formerly stood around 1.5% of GDP, but post-2009 this figure steadily plummeted until bottoming out at around 1.15% of GDP in 2014.

Defence Spending

Furthermore, in spite of anticipated upticks in nominal spending – as per the Defence Minister's September 2015 statement and

Like so many dual EU-NATO members, the Netherlands was quick to cash in on the "peace dividend" resulting from the end of the Cold War. Its once strong military shrank from above 105,000 troops in 1989 to just 37,000 by 2016. Capacity and capability atrophied, while an economic recession in 2009 and concurrent spike in the nation's budget deficit prompted Dutch lawmakers to seek ways in which to wring savings from the government checkbook. By 2016, the defence budget had fallen to

tions. The coalition agreement published on 26 October 2017 called for steadily increasing investment in defence by allocating additional resources eventually exceeding €1.5Bn per year beginning in 2021. The additional money is to restore basic military readiness levels and improve operational readiness by replacing and upgrading materiel and high-end hardware.

A new Defence White Paper released on 26 March 2018 calls for modernising defence via an infusion of over €25M across 15 years (2018 to 2033) for capital investment. The largest recipient will be the Royal Netherlands Navy, which will receive funding for projects to replace existing inventories of M-class frigates, mine countermeasures vessels, and diesel submarines. Army investments will be geared toward upgrading existing platforms, including the BUSHMASTER wheeled armoured vehicles, FENNEK armoured reconnaissance vehicles, CV90 infantry fighting vehicles, short-range air defence systems, and Panzerhaubitze 2000 self-propelled howitzers (SPHs). The Air Force will seek to upgrade and expand its APACHE combat and CHINOOK transport helicopter fleets, while adding the A330 multirole tanker transport (MRTT) aircraft under a multinational programme.

Funding over the short term will be topped up with an additional €910M in 2018, €1.21Bn in 2019, €1.41Bn in 2020, and €1.51Bn in 2021. Despite the additional funding, however, the defence budget is not expected to rise above 1.3% of GDP during this timeframe.

The missions of the Dutch military will remain largely the same going forward. The Netherlands has long served as a strong contributor to overseas operations under the NATO, EU, and UN flags, and emphasises flexibility, response, and interoperability when training and outfitting its armed forces.

Cooperative arrangements have been formed to maximise limited resources and forge stronger bonds with allied partners.

Photo: MoD Netherlands



A Dutch F-16 and a Dutch F-35 flying side by side

a new Defence White Paper published in March 2018 – the level of military investment as a share of national wealth is expected to hold steady at 1.2 to 1.3% of GDP out to 2022 and likely beyond.

Author

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1.17% of GDP and the military – the Army in particular – had become overstretched by operational demands ranging from co-operative security within a Benelux aegis to NATO/EU rapid response and peacekeeping missions, while being hollowed-out from within.

When a new four-party coalition government under Prime Minister Mark Rutte finally emerged in October 2017, the partners formed a consensus that favoured bolstering defence capability as a means of meeting NATO collective defence obliga-

These include the trinational Benelux Defence Cooperation (building on the binational Belgian-Dutch naval cooperation), the joint 1st German Netherlands Corps (1GNC) based in Germany, the cooperative Royal Netherlands Marine Corps and German Navy Sea Battalion arrangement (which reached Initial Operational Capability in September 2017), and the long-standing UK-Netherlands Landing Force active since 1973 (now part of the UK-led Joint Expeditionary Force), as well as the integration of the Netherlands' 11 Airmobile Brigade with Germany's new paratrooper commando division (operational in 2014).

The Royal Netherlands Army, in particular, has sought integration with the German Bundeswehr as a means of retaining core capabilities and punching above its weight regionally.

Aircraft Programmes

The premier defence project among all the Dutch military service branches is the F-16 fighter replacement programme. The original plan was to order 85 aircraft for the Royal Netherlands Air Force (RNLAf) at an estimated cost of €6.1Bn. That plan has now shrunk to an expected order of just 37 F-35s, two of which are test aircraft.



Photo: US Air Force

A Royal Netherlands Air Force C-130 HERCULES sits on a runway at an undisclosed location in Southwest Asia, 6 October 2017. The RNLAf has been supporting Coalition forces in Baghdad with supply missions.

The RNLAf F-16 fleet has shrunk since 2003, and going forward will be composed of 58 fighters assigned to four squadrons.

In the transport role, the RNLAf has two C-130H-30 "stretched" HERCULES, plus two C-130Hs rebuilt from C-130Q standard that were delivered in 2010. Additional fixed-wing transport is provided through the Strategic Airlift Capability (SAC) programme in which the Netherlands is allocated 500 flying hours per year on the C-17s based at Papa, Hungary.

The Netherlands and Luxembourg are purchasing two Airbus A330 multirole tanker transports (MRTTs) together, in

what they expect will evolve into a pooling and sharing arrangement to include European partners Belgium, Germany, Norway, and Poland. The purchase will see the two aircraft stationed at the Dutch air base at Eindhoven, where they will be exclusively operated by the Netherlands and Luxembourg until the fleet expands by another six air-to-air tankers under the NATO Support and Procurement Agency's Multinational MRTT Fleet (MMF) programme. The A330s will be delivered in 2020, just in time for the Royal Netherlands Air Force to retire its pair of KDC-10 tankers.



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The radar of a Dutch PATRIOT missile system

The RNLAf training role is assumed by a fleet of F-16Bs and PILATUS PC-7s. The latter were acquired between 1989 and 1997, and a replacement is expected to be sought between 2020 and 2027.

Fighter Fleet

The RNLAf fighter fleet is composed of 68 F-16AM fighters (another 21 F-16Bs form part of the trainer fleet with the PILATUS PC-7s). In 2005, these aircraft underwent the Pacer Amstel modification programme, which upgraded the aircraft to an M3 designation. The previous M1 update (introducing the Terma ALQ-213 electronic warfare management system on the aircraft) and M2 update (software update allowing LANTIRN pods to be added) were conducted in 1998 and 1999, respectively. The M4 software update quickly followed the Pacer Amstel programme in 2006, allowing the aircraft to carry improved infrared guided air-to-air weaponry. All 68 F-16s not being retired were to undergo the M5 upgrade through 2016.

The retirement of the F-16 fleet and its replacement have remained a source of disagreement in the Netherlands since 2009, when the full effects of the global financial crisis began to be felt in the Dutch economy. It had long been planned to have a successor to the F-16 fighters chosen by 2009, but political disagreement within the former Balkenende coalition government resulted in an agreement to postpone the decision until 2012.

That date was then pushed back to 2014 as per an agreement by the left-right coalition government formed by Prime Minister Mark Rutte (Rutte II) in October 2012.

Finally, following some 15-plus years of political wrangling, the government green-lighted what had long been considered a foregone conclusion. On 17 September 2013, it announced a purchase of 37 F-35s

via a €4.5Bn (US\$6Bn) special budget earmarked for the project (the total estimate was revised upward to US\$5.2Bn in September 2015). The Dutch Parliament's ratification of the government's choice of the F-35 on November 7, 2013, meant the RNLAf finally knew what it would operate in the years ahead.

The Dutch F-35s will be gradually brought into service between 2019 and 2024 as the F-16s are retired. The possibility of acquiring additional F-35s as production ramps up and units prices come down has not been ruled out, though reports emerged in November 2017 that, due to the high dollar exchange rate, funding for the final three units of the 37 may prove tight.

A Level 2 partner in the Joint Strike Fighter (JSF) programme, the Netherlands purchased two test aircraft at a cost of US\$250M as part of the programme's initial operational test and evaluation (IOT&E) phase (and invested US\$800M in the JSF development phase).

The first of these made its maiden flight on 6 August 2012 and was delivered to the Dutch in July 2013, from low-rate initial production (LRIP) Lot 3. The first flight of this aircraft conducted by an RNLAf pilot occurred in December 2013. The second aircraft was delivered on 14 February 2014, from LRIP Lot 4. Both are based at Eglin Air Force Base in Florida, where they are pooled with other F-35 trainers belonging to the US and UK as part of a common international test and evaluation (T&E) fleet.

Once the T&E phase is completed in mid-2019, the two aircraft will be utilised by the RNLAf primarily for training purposes, but also for occasional operational use. Dutch F-35 pilots will initially be trained in Italy on the Alenia Aermacchi M-346.

A first fully operational production batch order for eight new F-35s was announced by

the Dutch MoD on 26 March 2015. These units are to be delivered by 2019.

In terms of local industrial involvement in the JSF programme, former Defence Minister Jeanine Hennis-Plasschaert estimated in November 2016 that Dutch work share in component maintenance totaled €4.7Bn, with work potentially involving 100 Dutch businesses. This announcement came shortly after the Pentagon picked the Netherlands to act as the maintenance, repair, overhaul and upgrade (MRO&U) service centre for 14 components (mostly landing gear parts) of the F-35.

Then on 13 April 2017, the Dutch MoD inked an agreement for the Netherlands to act as an engine maintenance provider for the F-35 at its Logistic Center Woensdrecht. Another selection followed in August 2017, when the Netherlands was picked by the Pentagon to act as the F-35 spare parts centre and distribution hub for Europe.

Transport/Tanker Fleet

The RNLAf has a small fleet of transports and tankers. The transport fleet is composed of four C-130H HERCULES, the first two of which (both in the C-130H-30 "stretched" variant) replaced four Fokker 60 twin-turboprops in 2006. Two more aircraft were purchased in November 2005 under a US\$63M contract with Derco Aerospace. These ex-U.S. Navy EC-130Qs were converted to C-130H standard by Marshall Aerospace in the UK. The first reconfigured C-130H was delivered to the RNLAf on 2 March 2010, while the second was delivered on 15 July 2010.

Meanwhile, the RNLAf will fill any capability gaps by hiring commercial aircraft, and by participating in the NATO Strategic Airlift Capability (SAC) programme, which provides for three C-17As based at Papa Air Base in Hungary to be used by the Alliance's Heavy Airlift Wing.

Another project conducted through partnership involves the A330 MRTT aircraft. The Netherlands and Luxembourg are together purchasing two Airbus A330s in what they expect will evolve into a pooling and sharing arrangement to include European partners Belgium, Germany, Norway, and Poland. The purchase – largely financed by the Netherlands' MoD – will see the two aircraft stationed at the Dutch air base at Eindhoven, where they will be exclusively operated by the Netherlands and Luxembourg until the fleet expands by another six air-to-air tankers under the NATO Support and Procurement Agency's MMF programme. The effort to procure A330 MRTTs to outfit NATO partners is being led by OCCAR, the European organi-



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sation managing multinational weapons acquisition programmes.

In December 2014, a trio of European NATO partners – the Netherlands, Norway, and Poland – announced their intentions to open negotiations with Airbus to acquire up to four A330 MRTTs, yet so far only the Netherlands has taken an active step in the process. The two aircraft being ordered by

Helicopter Programmes

Under the "Defence after the Credit Crisis" white paper unveiled in April 2011, the Dutch armed forces' Netherlands Defence Helicopter Command (DHC) began to experience capabilities pressure. The plan required the retirement of the entire fleet of 14 AS 532 COUGAR transport helicop-

at US\$1.191Bn. The remanufacture will involve replacing the legacy engines with the more powerful T700-GE-701D engine and new transmissions, rotorblades and other components. Work is expected to be conducted between 2021 and 2025.

CH-47F CHINOOK

Despite initial budget frustrations and setbacks, the efforts to expand the capabilities of the Royal Netherlands Air Force in strategic and tactical air mobility have resulted in boosts to the fleet of CH-47 CHINOOKs. In January 2006, the Defence Materiel Organisation signed a production preparation agreement with Boeing for the purchase of six to nine new CH-47F CHINOOKs. A final direct commercial contract worth US\$335M was signed with Boeing on 15 February 2007, for six new-build CH-47F CHINOOKs to be delivered by 2011. The original delivery schedule of July 2009-January 2010 was pushed back due to software problems. The maiden flight of the first new CHINOOK CH-47F occurred on 25 January 2011.

Delivery of the first two new CH-47Fs to the Defence Materiel Command at Gilze-Rijen air base finally occurred in July 2012, after which modifications were made before handover to the DHC on 8 October 2012. The sixth and final CH-47F was handed over in early 2013.

Three of the CH-47F CHINOOKs operate out of 298th Squadron based at Gilze-Rijen air base. The other three are stationed in the United States as part of a permanent Chinook training detachment.

While the six CH-47Fs were being acquired, plans were put into motion to upgrade all 11 CH-47D CHINOOKs to the "F" standard starting in 2016. Then, in a surprise statement to Parliament on 16 May 2012, then-Defence Minister Hans Hillen stated that rather than upgrade the older D models, a purchase of 11 new-build F standard Chinooks would be pursued. This was deemed to be the more cost-effective solution to ensuring the Chinook fleet's viability through 2045.

An 11-unit CH-47F procurement was estimated at well over €250M, a cost that the MoD hoped to partially offset through the sale of the older CH-47Ds.

But, in another surprise step, the Netherlands placed a government-to-government sales request with Washington calling for 17 CH-47Fs instead of 11. The State Department signed off on the request, and a potential FMS deal estimated at US\$1.05Bn was announced to Congress on 19 March 2015. Then, on 7 September 2015, then Defence Minister Jeanine Hennis-Plasschaert announced to the lower house of

Photo: RNLAF



The maiden flight of the first new RNLAF CHINOOK CH-47F occurred on 25 January 2011.

the Dutch MoD will be delivered in 2020, just in time for the Royal Netherlands Air Force to retire its pair of KDC-10 tanker/transports.

UAV Programmes

The Dutch Defence Materiel Organisation (DMO) began the process of procuring medium-altitude, long-endurance unmanned aerial vehicles (MALE UAVs) in 2003, with consummation taking 15 years to accomplish. The on-again, off-again project was postponed in 2005, brought back in 2010, and then postponed again after 2011. Finally, a tender was published on February 6, 2012. Then, on 21 November 2013, then-Defence Minister Hennis-Plasschaert announced in a letter to Parliament that the MoD had selected the MQ-9 REAPER as its MALE UAV solution.

A sale of the REAPER to the Netherlands was cleared by the US State Department on 6 February 2015. The total sales package – which includes training, the four UAVs, four mobile ground control stations, and two spare engines, plus additional elements and subsystems – is estimated at US\$339M in value. But it was not until 17 July 2018, at the Farnborough Airshow that a contract was finally signed for four MQ-9 REAPER Block 5 UAVs.

A later amendment to that plan noted that eight of the COUGARs would instead be retained through 2019 to serve in the search-and-rescue (SAR) role. These, however, may remain in service through 2023 (the end date for their useful service lives) due to issues with the NH90s.

In the meantime, the Royal Netherlands Navy's multipurpose, shipborne Westland LYNX SH-14Ds were retired on 11 September 2012, in favour of the NH90 NATO Frigate Helicopter (NFH90). Their retirement is being followed by that of the AB-412s, which have been used in the SAR role and are also being supplanted by the NFH90. The RNLAF acquired 30 AH-64D APACHE Block I attack helicopters from 1997 through 2002. A total of 28 remain active in the RNLAF inventory. The service intends to retain these units in operational use out to 2050. In order to ensure their serviceability, the MoD will put the fleet through a remanufacture upgrade that will bring them up to AH-64E GUARDIAN standard. An earlier upgrade to Block II status was undertaken from 2013 through 2016.

On 20 February 2018, the US Defence Department's Defence Security Cooperation Agency (DSCA) notified Congress that the US State Department had approved a Foreign Military Sale (FMS) for the remanufacture/upgrade of the Dutch APACHEs to AH-64E GUARDIAN standard. The notification estimated the cost of the project

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Parliament that the Netherlands would purchase 14 new-build CH-47F MYII helicopters having a Common Avionics Architecture System (CAAS); i.e., the same as on the models operated by the US military. Hennis-Plasschaert stated that the purchase would be made in December 2015 in order to take advantage of the

copter (TTH) and marinised NATO Frigate Helicopter (NFH90).

The Netherlands initially ordered 20 NFH versions of the helicopter. In December 2005, the order was altered to 12 under a new contract, with the remaining eight to come in the Maritime Tactical Transport Helicopter (MTTH) configuration. An op-

The Dutch NFH90s are operated by two squadrons: 860 Squadron at De Kooy (12 NFH90s) and 300 Squadron at Gilze-Rijen (8 NFH90 MTTHs).

Warship Programmes

The Royal Netherlands Navy (RNLN) has seen significant changes since 2004, shedding six of its eight KAREL DOORMAN class M frigates and concentrating on a more expeditionary-based outlook. The effort fell under the Dutch "Navy Study 2005" (it is also referred to as the "2005 Naval Transformation Plan") calling for a versatile RNLN fleet that can both protect home waters and act as a maritime base from which to initiate and support expeditionary efforts on land.

As part of the reorganised force, four ocean-going patrol vessels, a second landing platform dock, and a joint support ship (KAREL DOORMAN) were ordered, with the latter commissioned in 2015 to replace the replenishment oiler HNLMS ZUIDERKRUIS.

Also in the works is the €50M to €150M Service Life Extension programme for the RNLN's four WALRUS class submarines. The WALRUS class submarine SLEP – a programme referred to as the Instandhoudings programma WALRUS-klasse (IP-W) – began on 13 May 2013, and ran through 2018. The SLEP will enable the RNLN to keep the vessels in service until 2025-2030. The ships were designed and built by Dutch industry and entered service in the early 1990s.

The Royal Netherlands Navy is attempting to secure approval for the launch of a WALRUS class replacement project entailing new flexible submarines that would enter service at the time the elder submarines neared their end-of-life date. The Dutch government has announced its intention of maintaining a future submarine component as a crucial niche strategic capability, and the project is in the earliest research phase. A refined research phase, type downselect, and contract negotiations with a supplier are to be undertaken by 2021 in hopes that the lead submarine will enter service by 2027.

The two remaining KAREL DOORMAN class M frigates, VAN SPEIJK and VAN AMSTEL, began two-year upgrades (the first began in September 2010 and the second in October 2012). Following their upgrades, these ships are slated to remain in RNLN service through 2024.

In the meantime the respective defence ministries of Belgium and the Netherlands signed a letter of intent on November 30, 2016, regarding the joint procurement of four new frigates and 12 new minehunters. Belgium will be tasked with the minehunter

Photo: MoD Netherlands



In order to replace its ageing fleet of AS 532 COUGAR and LYNX helicopters, the Netherlands has procured the NH90 helicopter. Depicted is a Royal Netherlands Navy NH90 NATO Frigate Helicopter.

economies of scale created by the US's own second multiyear CH-47F procurement package.

In the meantime, the Netherlands would move forward with modernisation of the six existing CH-47F NLs.

On 14 April 2016, Boeing was awarded a contract by the US Department of Defence for the manufacture of 12 CH-47Fs and their delivery to the Netherlands. The value of the contract was US\$308M. A follow-on modification to the contract was announced by the Pentagon on 28 April 2017, to include the final two CH-47F units, thus bringing the full order up to 14 helicopters. All deliveries are to be wrapped up by 31 December 2020.

Under the 2018 Defence White Paper there is mention of adding three more CHINOOK CH-47Fs in the future, thus completing the full 17-unit quantity outlined in the original 2015 FMS request.

NFH90

In order to replace its ageing fleets of AS 532 COUGARs and Royal Netherlands Navy AgustaWestland SH-14D LYNX helicopters, the Netherlands has procured the NH Industries NH90 helicopter. Developed by a consortium including then domestic Stork Fokker, the NH90 is produced in two primary variants – Tactical Transport Heli-

tion for an additional two helicopters was included in the new contract.

In April 2007, the Dutch MoD announced delays to the programme that pushed back the initial delivery schedule to 2009. Under the revised plan, the first two NH90s were to be delivered in late 2009, followed by four in 2010, five each in 2011 and 2012, and a final four in 2013. The latter dates ultimately became a victim of further delays; delivery of the first Dutch NFH90 occurred on 21 April 2010. The second NFH90 was delivered on 21 July 2010.

The first NFH90 operationally deployed was assigned to the EU Naval Force's counter-piracy "Operation Atalanta" in the first half of 2013. A second unit was deployed to the Caribbean in the latter half of the same year.

By June 2014, 12 NH90s had been handed over to the DHC at the Maritime Air Station De Kooy in Den Helder, but just five had been delivered in the so-called Full Operational Capability (FOC) configuration (the first Dutch FOC-configured NFH90 was delivered on 30 January 2013).

The others had arrived in Medium Operational Capability (MOC) configuration, with two having since been returned to Italy for update to FOC configuration.

The remaining five units in MOC condition were to be brought up to FOC standard throughout 2018.



element, under which delivery of the new minehunters to replace the existing TRIPARTITE class is to begin in 2023. Belgium and the Netherlands will receive six minehunters apiece. For its part, the Netherlands will be tasked with overseeing the frigate project under which ships displacing 4,000-5,000 tonnes will be built, with anti-submarine warfare to be their primary mission.

A final Memorandum of Understanding (MoU) was signed by the two countries in 2018, followed by final contracts for ship production. Secretary of State for Defence Barbara Visser announced to Parliament on 2 May 2018, that the Navy will be getting its two new frigates and six minehunters, plus an additional combat support ship (CSS) to supplement the joint logistic support ship KAREL DOORMAN and enable the Navy to always have an available support ship.

The new CSS will be purchased off the shelf to expedite delivery, which is expected by 2023. The first of the two new frigates will be delivered in 2024-2025. Delivery of the six new minehunters is planned for completion by 2030.

Missile Programmes

The Netherlands is involved in the NATO SEASPARROW consortium, which collectively purchased 294 Evolved SEASPARROW Missiles (ESSMs) from Raytheon for US\$223M. The Dutch ESSM Block 1 air defence systems on the four DE ZEVEN PROVINCIE class air defence and command frigates are being upgraded to Block 2 standard, which will be the standard utilised on the successor class to the two M-class frigates.

The Netherlands MoD is also upgrading the Raytheon Mk 48 heavyweight torpedoes used on the Royal Netherlands Navy's four WALRUS class submarines. The RNLN uses a Dutch version of the Mk 48 designed in the 1970s for deployment in deep waters. This torpedo has only limited shallow-water capabilities, and the Dutch MoD wants to adopt an Australia-Canada-US model for use in shallow waters. An FMS order for Mk 48 Mod 7 advanced-technology torpedo conversion kits, at a cost of US\$150M, was placed on behalf of the Netherlands via the Pentagon's DSCA on 29 July 2010.

The Royal Netherlands Army's short-range air defence systems are to receive midlife upgrades as per the 2018 Defence White Paper.

Patriot Modernisation

Rather than pursue the acquisition of a new air defence missile system such as the Lockheed Martin MEADS, the Netherlands is opting to upgrade its existing Raytheon-

Photo: Kees Torn



In 2015, the Royal Netherlands Navy commissioned the joint support ship Zr.Ms. KAREL DOORMAN to replace the replenishment oiler HNLMS ZUIDERKRUIS.

produced PATRIOT batteries. These systems were approaching the end of their useful service lives when then Defence Minister Jeanine Hennis-Plasschaert provided testimony to the Dutch Parliament Defence Committee in the fall of 2015 that a service-life extension of the PATRIOTS made more sense than an outside procurement. In anticipation of the modernisation process, the Dutch PATRIOT batteries were removed from Turkey's border with Syria in the fourth quarter of 2015.

The Netherlands awarded Raytheon the PATRIOT upgrade contract on 6 October 2016. The contract involves the service life extension of the existing PATRIOT systems, plus the acquisition of Modern Man Stations (MMSs) from Raytheon. The MMSs will replace the legacy control panels in the command and control shelters of the existing Dutch PATRIOT systems.

The modernisation process began in March 2018 and will run through 2022, and once completed will ensure the PATRIOTS remain serviceable through 2040.

Vehicle Programmes

After deciding to phase-out and mothball its remaining fleet of LEOPARD 2 main battle tanks (MBTs) in April 2011, the Royal Netherlands Army disbanded its two tank battalions a month later in May 2011. But by September 2015, the decision to discard MBT capability altogether had been reversed. The Netherlands sold its remaining stock of 16-18 retired LEOPARD 2A6 tanks to Germany at a symbolic price in return for the right to use them from German stocks. As such, all 18 units are being upgraded by Krauss-Maffei Wegmann to the 2A6MA2 standard by 2019. These will equip a Dutch tank company within the German Army's Panzerbataillon 414. This tank

battalion is a joint Dutch-German undertaking begun in 2015. It comes under the command of the Dutch 43 Mechanised Brigade, which in turn forms part of the German 1st Panzer Division.

Under the 2018 Defence White Paper, the Army's inventories of BUSHMASTERS, FENNEKS, CV90s and PzH 2000 self-propelled howitzers will all receive midlife updates roughly between 2021 and 2023. The Army will also receive 12 new-build CBRN (chemical, biological, radiological and nuclear) reconnaissance vehicles, procured through a pooled arrangement with a European NATO ally from 2018 through 2022. The Netherlands Army is currently seeking a solution for its Wheeled Vehicle Replacement programme (DVOW in Dutch acronym) under which new air assault and light-weight protected vehicles will be acquired.

BOXER Multi-Role Armoured Vehicle

After much drama and hesitation, the BOXER programme is moving forward to meet German and Dutch Army requirements. The BOXER is an 8x8 Multi-Role Armoured Vehicle (MRV) being produced by the Armoured Technology (ARTEC) consortium. The BOXER will replace the obsolete YPR-765 tracked infantry carriers still in service with the Royal Netherlands Army. The ARTEC consortium, based in Munich, consists of Krauss-Maffei Wegmann (36%) and Rheinmetall Landsysteme (14%) of Germany, and the Dutch company Stork (50%). The BOXER MRV is being built for high protection against both direct and indirect fire weapons. It is being fitted with an air conditioning system, a heating system, a fire detection and suppression system, an NBC (nuclear, biological, chemical)

**A Dutch LEOPARD 2A4 MBT**

system, and a GPS; it will be outfitted for C3I workstation integration.

In 1999, Germany and the UK signed a development contract regarding the BOXER. The Dutch entered the programme in 2001. But in July 2003, the UK made official its long-expected withdrawal from the trinational BOXER armoured vehicle programme. German participation often appeared tenuous because of constant reports that Germany was critical of the programme. Any indication that Germany was having doubts would have effectively killed the programme.

Britain's departure from the programme caused the cost of the BOXER to rise to €3M from €1.7M. With escalating costs in mind, the Dutch MoD advised ARTEC that it must present an acceptable production price by September 2005, and correct several defects by introducing technical modifications. The ARTEC bid would also have to exhibit a level of Dutch industrial participation in order for it to be deemed palatable. Faced with these stipulations, ARTEC asked for an extension, which it received from both the Dutch and Germans. But on 28 February 2006, the Dutch state secretary in the MoD, Cees van der Knaap, reported in a letter to Parliament that the revised unit price for the BOXER was still too high. The new price presented by ARTEC was around €2.6M to €2.9M per vehicle. By this time, the Dutch order had changed due to operational requirements. The new requirement was for 257 new vehicles (from an original request of 200) in five variants: command and control, battlefield repair and recovery, ambulance, transporter, and combat engineer. Disgruntled by the ARTEC proposal, the Dutch MoD proposed reopening the MRAV competition to include Giat Industries' VBCI, Iveco Fiat/Oto Melara's CENTAURO, Swiss General Dynamics' MOWAG PIRANHA IV, and Patria's AMV.

In response, ARTEC's Dutch manufacturer, Stork PWV, began renewing negotiations to reduce the unit price to an acceptable level. Due to the price reductions, the MoD, under van der Knaap, advised Parliament that it wanted to go ahead with the programme. Based on this recommendation, the Dutch Parliament approved plans to proceed with the BOXER procurement. On 19 December 2007, both Germany and the Netherlands approved production of the BOXER.

The approved order was scaled back to the original production requirement, which called for 200 BOXER vehicles in five variants (command post – 60 units, cargo – 27 units, ambulance – 52 units, driver-trainers – 8 units, engineer model – 53 units). This mix was altered under a new agreement with OCCAR signed on 25 May 2016. Instead the Dutch will receive 36 command post vehicles, 92 engineering variants, and 12 cargo variants to go with eight driver-trainer models and the 52 armoured ambulances.

The value of the contract for 200 BOXERS is an estimated €624M (US\$783M), with 30-year operating costs reduced to €938M (US\$1.177Bn) from the original estimate of €1.125Bn (US\$1.4Bn).

Deliveries of the first units – eight driver-training variants – occurred in 2011, with first delivery of the ambulance variant (NL AMB) occurring on 7 April 2014. OCCAR said that all deliveries would be completed by 2018, and the last series-produced unit rolled off the production line on 17 July 2018. However, due to the need to create financial space for the F-35 acquisition programme, the MoD has opted to sell 12 BOXERS prior to their handover to Dutch forces.

The BOXER vehicle has been given the designation Pantser Wiel Voertuig (PWV) by the Royal Netherlands Army. The BOXER is used by the RNLA in select

support roles for infantry units utilising the Hagglunds CV9035 infantry fighting vehicle.

Electronics Programmes

The Netherlands requested a possible FMS of 32 AAR-57A(V)7 common missile warning systems (CMWS) from the US. A formal notification to Congress regarding the sale, valued at an estimated US\$58.2M, was made by the Pentagon's DSCA on 10 July 2017. The prime contractor for the project is BAE Systems. The new missile warning systems will equip the RNLA's AH-64D APACHE helicopters.

VOSS Soldier System

The Netherlands is developing its own individual soldier system called VOSS (Improved Operational Soldier System). The programme was launched in 2008, and the first elements to be ordered were a "smart vest" and a C4I module upon which other aspects of the system – ballistic protection and load carriage – will be integrated. This order was expected in 2013, following the issuance of a Request for Proposals in December 2011. The acquisition of up to 5,500 complete infantry suits was planned to begin in 2014 and run through 2018. The small arms element of the programme did not proceed until 2015.

SMART-L Air Search Radar Upgrade

The Dutch MoD plans to upgrade the SMART-L air search radars on the Royal Netherlands Navy's four DE ZEVEN PROVINCIE class frigates with an extended long-range (ELR) mode. The announcement was made on 26 September 2011, and a €116M contract was extended to Thales Nederland by the DMO in June 2012. The first upgrade was fitted by 2017, and the entire upgrade programme will be completed by 2021.

When the insertion of the new technology is complete, the ships will be able to detect and track ballistic missiles from a range estimated at 2,000 kilometres. Once enhanced, the DE ZEVEN PROVINCIE frigates may become part of NATO's Active Layered Theater Ballistic Missile Defence programme.

The Royal Netherlands Air Force is acquiring land-based versions of the SMART-L radar system as a replacement for its Thomson-CSF Medium Power Radars (MPRs) acquired in 1972. The new SMART-L radars have a ballistic missile defence capability. They will be located in Wier and Herwijnen. FOC for these radars is slated for 2020. ■



The Netherlands' Maritime Defence Industry

Guy Toremans

A powerful maritime nation from days of old, with strong trading links around the world, the Netherlands gained an almost unrivaled expertise in shipbuilding, naval research and other naval-related matters.

This resulted in the creation of strong synergies and interactions between the MoD's Defence Materiel Organisation (DMO), industry, and research & development (R&D) institutes. These three actors form one of the strongest maritime clusters in the world, the so-called Dutch Naval Cluster with a workforce of 37,693 people and an economic value in the Netherlands estimated to be €1.107Bnn in 2018, comprising a direct economic value of €719M and an indirect economic value of €388M.

The Maritime Defence Cluster

The Defence Materiel Organisation (DMO)

DMO is responsible for the procurement of all military equipment for the Netherlands Armed Forces. The procurement of material with a value of US\$6.5M or more has to follow the Defence Materiel Process (DMP). Such acquisitions are categorised as either mandated or non-mandated projects. The final producer is selected from those firms that are on this qualified source list. As a consequence it is important for companies to request placement on the qualified source list for military procurements, because the Netherlands does not advertise procurement opportunities for military equipment. Foreign firms that do business with the Netherlands could be subject to some type of offset arrangement, with these offsets aimed to help maintain and improve Dutch defence-related industries.

The Research Institutes

- The Toegepast Natuurkundig Onderzoek (TNO) is a 'one-stop-shop' partner for Research and Development (R&D) of defence-related products, including military operations and equipment, op-

erational decision-making, instruction, training and simulation. As an independent subcontractor of the technical knowledge the DMO wants to purchase, TNO attracts industrial partners for joint development and commercialisation of product innovations. One of the organisation's latest developments is the 'Gaudi

The Maritime Defence Industry

Three companies can be regarded as the leaders of the maritime defence industry: Damen Schelde Naval Shipbuilding (DSNS), Thales Netherlands and RH Marine Group (partner of Bakker Slidrecht

Photo: Thales



Thales Nederland's SMART-L MM radar. Equipped with a prototype HNLMS DE ZEVEN PROVINCIEEN participated in a demonstration off the coast of Scotland in October 2015. The radar detected and tracked an exo-atmospheric ballistic missile travelling at a speed of 7,000 km/h and provided real-time target information to a USN destroyer for the engagement of the threat with an SM-3 missile.

Project' in which TNO, Thales, RH Marine, Alewijnse and the DMO jointly developed an Integrated Mission Management System, featuring an Integrated Combat, Platform & Bridge Management System with an 'open architecture'.

- The Maritime Research Institute (MARIN) which acts as a consultative service in the fields of mathematical modeling, and model experiments for shipbuilding and shipping

and Pon Holdings). Another 45 companies, many of which are niche-oriented and active in both the civil and military domain, and members of the Dutch Industry for Defence and Security Association and/or the Netherlands Maritime Technology Association, are delivering dedicated equipment to the three core companies. In addition, there are about another 100 smaller contractors delivering generic products.

Author

Guy Toremans is a freelance naval journalist based in Belgium.

The Core Companies

Damen Schelde Naval Shipbuilding

(DSNS) is one of the foremost shipbuilding groups in the world and part of the Damen Shipyards Group which had a turnover in 2018 of some €2Bn and a workforce of more than 12,000 employees, of which some 3,500 are in the Netherlands. The Group owns 54 companies worldwide, including 34 shipyards, of which 16 are in the Netherlands, which delivered 176 ships in 2018 – 76 tugs/workboats, 3 offshore vessels, 40 high-speed craft and ferries, 21 pontoons and barges, 13 dredgers, 5 yachts and 18 ships for navies, coast guards and police.

DSNS has long track record in the development and construction of a wide variety of platforms either on its own shipyards or at non-Damen shipyards under the Damen Technical Corporation programme. The company's portfolio covers the complete range of vessels in the surface combatants sector for navies, coastguards and maritime law enforcement agencies; from 7-metre-long RHIBs, and fast interceptors, through to frigates, offshore patrol vessels, inshore/STAN patrol vessels, naval auxiliary vessel, multirole auxiliary vessels, landing ships and landing craft, up to support vessels more than 200 metres in length and landing platform dock ships.

In recent years, DSNS gained a strong export position with its Ship Integrated Geometrical Modularity Approach (SIGMA) type platforms. This successful design covers the whole spectrum from offshore patrol vessels to frigates, ranging from 50 up to 150 m long and where each vessel can be tailor-made



Photo: DSNS

Variant of the Swedish A26 design as it is on offer from DSNS and Saab Kockums in the scope of the RNLN's WALRUS replacement programme.

to the client's operational requirements. The SIGMA line has firmly established Damen Schelde Naval Shipbuilding's export credentials with sales to the Indonesian, Moroccan, and Mexican navies, the latter being the Patrulla Oceánica de Largo Alcance (POLA) type – a SIGMA 10514 variant, constructed at the ASTIMAR 20 Shipyard in Salina Cruz under the aforementioned Damen Technical Corporation programme, and a SIGMA-variant also being proposed to the Romanian Navy. Another innovative design is the CROSSOVER hybrid ship concept, a platform with the fighting power of a frigate, and the endurance, versatility and flexibility of an amphibious ship.

DSNS was also vying for the 12-ship New Generation Mine Countermeasure Vessels

(MCMVs) replacement programme for the Belgian and Dutch navies, through a 'Temporary Trade Association' with IMTECH Belgium, with a 91-metre-long MCM-mothership and a displacement of approx. 3,025 tonnes, based on the training vessel for the Australian Navy, MV SYCAMORE. However, on 15 March Naval Group and ECA Group /Belgium Naval & Robotics gained the contract for the construction of the 12 units.

DSNS's most ambitious campaign is to re-establish submarine construction in the Netherlands in partnership with Saab Kockums to jointly pursue the WALRUS replacement programme. The two companies are offering an enlarged, extended-range derivative of Sweden's new



Picture: ESD archives

The four Dutch OPVs of the HOLLAND class are equipped with the IM-400 integrated mast from Thales.



Dutch Naval Companies

Beyond the "big players" the Dutch naval industry comprises a large number of specialist companies

Shipbuilding and Hull

Bayards Aluminium Constructies – aluminium structures, bulkheads for radar masts, C containers, ship superstructures and decompression tanks

Bolidt Kunststoftoepassing – shipdeck specialist

Hertel Marine Services – fire and heat insulation and accommodation installations

Hull Vane – underwater spoilers, for example, fixed foils below the stern

Royal IHC – a maritime technology innovator with expertise in engineering and manufacturing high-performance integrated vessels and equipment

SMI Groep – custom-made welded parts

Solico – design and development of composite products

Ten Cate Advanced Composites – composite protection for accommodation, ammunition storage rooms, mission-critical compartments, bridge and comms compartments, engine rooms

VDL Defence Technologies – emissions abatement systems

Venko COBI-Neutra – corrosion protection and painting of naval units

Vogel Tube Bending – tubes and pipes

Sensors and Command Systems

ABIOM – communications systems

Airborne Composites – UAVs

Atmos UAV – high-end drones, aerial surveying and data collection systems

Alphatron Marine – supplier of integrated bridge solutions

Alewijnse Marine – electrical and automation systems, communication equipment, Integrated Bridge Management Systems (IBMS), Integrated Platform Management Systems (IPMS), Power & Energy Distribution Systems Integration

Bakker Sliedrecht – design and installation of electrical systems

CSI control – control & monitoring solutions

De Regt Marine Cables – cable solutions for sonar systems

Nedinsco – optical systems, cameras and periscopes

Terma – C2/C3/C4I solutions

Propulsion and Engineering

Discom – exhaust systems

Eekels Elektrotechniek – electrical drive systems, power converters, shore power connections

EST-Floattech – lithium-polymer batteries and electronic systems for submarines

MAN Diesel & Turbo Benelux – diesel and gas/LNG engines

Nevesbu – engineering office for naval platforms, submarines in particular

Pon Power – propulsion and electric power generation systems

SARC – software for ship design, fire-fighting and damage control (FF/DC) systems

Siemens Nederland – diesel-electric propulsion systems, power generation, gearboxes,

Voith Turbo – propulsion systems

Wärtsilä Nederland – propulsion systems,

Support Services

Bachmann Electronic – modular high-end automation systems

Bosch Rexroth – Underway Replenishment (UNREP) and radar stabilisation systems

Contour Advanced Systems – installation of navigation bridge systems and bridge simulators

Croon Elektrotechniek – installation of electronic systems.

Globecomm Maritime – communication systems

Hatenboer Water – specialist in reverse osmosis systems

Heinen & Hopman Engineering – ventilation, air conditioning, refrigeration and central heating

Johnson Controls – refrigeration, ventilation and air conditioning systems

Mafo Naval Closures – hydraulic doors for naval units

Rohde & Schwarz Nederland – telecommunications

Rubber Design – one of the market leaders in suppressing noise and engine vibrations

Stork-Bronswerk – cooling and climate systems

THR Marine – deck equipment, such as winches, windlasses, capstans, mooring winches

Trelleborg Antivibrations Solutions – composite and thermoplastic bearings, shock-absorbing systems

Van Halteren Special Products – high-tech power packs, cooling systems and Nuclear, Biological and Chemical (NBC) protection, climate control and cooling of electronic equipment, chilled water plants

A 26 submarine, with Saab building pressure hull sections in Karlskrona after which these hull sections will then be shipped to Vlissingen for final outfitting.

Thales Nederland, headquartered in Hengelo, is part of the French Thales Group. Although part of this French multinational, the Dutch state still owns shares and, as such, can veto the export of sensitive products. Thales Nederland is a Centre of Excellence in the field of radar and sensor technology. The company is one of the market leaders of naval radar technology and combat management systems. Thales Nederland, with a workforce of about 1,700 people, had a turnover of some €500M

in 2018, and its systems are operational in more than 30 navies.

Amongst the company's latest developments is the range of 4D dual-axis multi-beam AESA radars (the NS100, NS200, SM400 and Europe's first fully digital L-band radar SMART-L MM) and the I-MAST family of integrated modular masts. Of particular note, the I-MAST 400 is installed on board the four HOLLAND class offshore patrol vessels and the Joint Support Ship HNLMS KAREL DOORMAN. Another innovative radar system is the SMART-L Early Warning Capability (EWC) radar, with an impressive range of up to 2,000 km and capable of interfacing with the American BMD (Ballistic Missile De-

fence) system. This radar is under contract for the Royal Netherlands Navy's four DE ZEVEN PROVINCIEËN class frigates. And in cooperation with DMO, Thales is developing the Above Water Warfare System (AWWS) for the Royal Netherlands and Belgian navies' next-generation multipurpose frigates, including a fully digital dual-band X/S radar suite, consisting of an integral combination of Active Phased Array Radar (APAR) and Sea Master 400 radars.

RH Marine is part of the RH Marine Group (RHMG), the Dutch leading system integrator of technical expertise and innovative, sustainable technology solutions in the fields of power generation/distribution,

ship automation, navigation and communication, integrated bridge and platform management systems, propulsion solutions, fire-fighting and fire protection technology and heating/ventilation systems. In 2018, the company had revenues of some €340M and a workforce of 1,350 full-time equivalents.

cific submarine knowledge and expertise joined forces. The DUKC-members comprise Airborne Composite, Bolidt, Bosch Rexroth, Damen Schelde Naval Shipbuilding, De Regt Marine Cables, EST-Floattech, Heinen & Hopman Engineering, Nedinsco, Nevesbu, RH Marine, Thales Nederland, Trelleborg Antivibra-

Navy's Future Submarine programme. The two companies say they are already engaging with potential Dutch industry partners.

Outlook

This summary shows that the Dutch maritime defence cluster has highly developed naval technology to offer and has formed numerous partnerships and consortia over the past years, but nonetheless, the future still holds many challenges. The domestic market is too small to support the available expertise, which is why exports are a prerequisite for preserving the Netherlands' knowledge. Consequently, important steps towards positioning the Dutch naval defence industry on international markets in general and on the European market in particular, are imperative.

Taking into account the shrinking defence budgets, cooperation in the maritime defence-related industry has become indispensable and vital. Few in the shipbuilding industry doubt that mergers and alliances are necessary in a sector that has 11 prime contractors and 23 vying with one another to build Europe's warships. With the publication of its Defence Industry Strategy (DIS), the Dutch Government voices the importance it attaches to the maritime defence industry and encourages the domestic companies to participate in international cooperation. It is crucial that naval platforms and naval-related systems should be designed with exports in mind, in order to give the companies an opportunity to develop their own local industry. Therefore, the Royal Netherlands Navy's procurement plans are a forecast indicator; it shows in which areas advertising can be made in the future, whereby the parent navy serves as an important reference for entering the international market.

However, as many of the companies mentioned above have a strong civil sector, it is uncertain whether they are prepared to maintain defence capabilities and continue to offer naval products in the future. This depends to a large extent on the companies' assessment of the expected order situation and on the political climate in the Netherlands, which is why the state must continue to promote research and development, secure national procurement, take a reliable position on arms exports and adopt an active political stance in arms cooperation. Ultimately, a robust grey ship market is essential to fully utilise the highly specialised workforce of the Dutch maritime defence industry. ■



Photo: DSNS

Surface combatants of DSNS' SIGMA design can be flexibly adapted to dedicated customer requirements. Shown here is a MARTADINATA class frigate of the Indonesian Navy.

Recently, RH Marine has been involved in the mid-life upgrade programme of the Dutch WALRUS class submarines and is commissioned to deliver the low-voltage systems for the Royal Navy's new T26 frigates. Some of RH Marine's latest developments are the integration of an optical bearing device (OBD) in the military digital chart system WECDIS, and the R95 Ellipse, a special algorithm which calculates the most likely position of the ship with 95% accuracy.

The Dutch Underwater Knowledge Centre (DUKC)

While the Netherlands has no indigenous submarine builder, following the demise of RDM Submarines Shipyard back in 2004, it has retained a significant level of technical and engineering knowledge through the Dutch Underwater Knowledge Centre (DUKC) – a collaboration platform under the Netherlands Industry for Defence and Security Association, by which those Dutch companies with spe-

cialised submarine knowledge and expertise joined forces. The DUKC-members comprise Airborne Composite, Bolidt, Bosch Rexroth, Damen Schelde Naval Shipbuilding, De Regt Marine Cables, EST-Floattech, Heinen & Hopman Engineering, Nedinsco, Nevesbu, RH Marine, Thales Nederland, Trelleborg Antivibra-

tion Solutions, Van Halteren Special Products and Verebus. DUKC is already fulfilling an important role in the modernisation of the RNLN's WALRUS class submarines. The ambition of the DUKC members is to contribute to the replacement of the WALRUS class, particularly in the design and equipment areas, and eventually construct the new boats with the help of an international yard with submarine programme management experience. On the other hand, the Dutch company Royal IHC and the French Naval Group signed an agreement to become partners in the bid for the WALRUS class submarine replacement programme. Under the terms set out in this partnership, Naval Group is to develop the submarine design and Royal IHC perform the construction and outfitting of the end product, leveraging capacity and skills within the Dutch maritime sector. Naval Group is offering a new design sized between its SCORPENE design and the SHORTFIN BARRACUDA proposal developed for Royal Australia



“It is very important for us to keep our OEM cluster alive”



Photos: DSNS

Interview with Richard Keulen, Director Naval Sales Support, Damen Schelde Naval Shipbuilding (DSNS)

ESD: Now that the Dutch Government has identified a number of projects to modernise the Royal Netherlands Navy (RNLN) fleet, your company has moved into the spotlight. DSNS is also a strong European player. Could you give us some insight into DSNS' situation today?

DSNS: Since the Dutch fleet is ageing, we are now seeing programmes to replace frigates, MCM vessels (MCM – Mine Counter Measures) and submarines. There is also a programme for a new logistic supply vessel to be commissioned in 2023.

First, let's have a look at the Dutch Naval Cluster which is a group of companies around a so-called OEM (Original Equipment Manufacturer) capability and which is well established in Europe. Essentially, the Netherlands has a full-fledged industry cluster that can develop complex ships from a clean sheet of paper up to the very ends of operation, maintenance and midlife updating.

DSNS constitutes the OEM capability of that cluster. Formerly called Royal Schelde, DSNS has built ships for the RNLN since the 1870s. It is a very old company, and in the last decades we have developed very successful launching customer projects; we have initiated innovative projects for the RNLN offering room for improvement, new developments, future-oriented weapons and sensors and so forth. This allows us to turn these novelties into successful export items which in return strengthen and maintain our naval cluster.

In 2000, Royal Schelde was taken over by the Damen Shipyards Group which is the largest shipbuilder in the Netherlands and a global player, with more than 12,000 employees at 35 facilities worldwide. Damen Shipyards Group has a wide portfolio, ranging from more civilian-based security solutions like OPVs (Offshore Patrol Vessels) to tug boats, pilot vessels and cruise vessels. By acquiring DSNS, Damen added an entire naval portfolio to its capabilities, ranging from military OPVs, high speed patrol vessels to full-fledged air defence frigates, amphibious units and supply ships. DSNS is responsible for development, engineering, building, integration and delivery of naval ships to its navy customers. All in all, we can offer the entire naval portfolio, ranging from the lower end like water police vessels all the way up to heavy combatants. In addition, we have strong Dutch partners like RH Marine, a partner

we engage often with in platform automation. We also contract other European partners, e.g. for effectors. But basically, in the Netherlands we have all the expertise needed to develop complex naval projects. This is why the cluster is of strategic importance for the Netherlands.

Currently, we are involved in a Dutch programme which is an addition to the Joint Support Ship. The Netherlands has a worldwide operating blue ocean fleet, heavy frigates, heavy amphibians, and two replenishment ships. Due to budget cuts and retiring of vessels, we ended up for a very short time with no logistic support vessels at all and the joint support ship HNLMS KAREL DOORMAN, the latest unit provided to the RNLN, now executes replenishment at sea tasks.

The KAREL DOORMAN has three main functions: underway replenishment, strategic transport and supporting amphibious



Artist impression of what the Royal Netherlands Navy's new combat support ship DEN HELDER will look like

ous or littoral operations. Thus, she has various tasks and cannot be restricted to replenishment. As in many other countries, the budget of the Dutch MoD has grown, which is why an additional dedicated support ship can be commissioned, and we are now proposing an engineering solution and a design for that ship to the MoD; we will be contracted to build that ship, HNLMS DEN HELDER.

de Guerre des Mines) in Ostend, Belgium. This is also where Belgium's NATO Centre of Excellence for MCM is. Now both nations have decided to replace their MCMVs and frigates. Belgium is in charge of the MCMV project, while the Netherlands is responsible for the frigate programme of both nations. It will start shortly after the MCM programme and the delivery of the units will commence at

tend to develop from such launching customer projects. There are several examples, one being the air-defence and command frigate of the DE ZEVEN PROVINCIEËN Class developed under a similar launching customer set up. Once provided to the Navy, we were able to turn that high-end ship into a lighter export family of ships, the so-called SIGMA series.

Now we are about to deliver the tenth SIGMA series ship, this time to Mexico. Based on that launching customer idea, we have been able to export to a number of navies without the support of the Government. This is how our Naval Cluster survives and this is why this set-up is so important to us. So, when it comes to the M frigate, we are looking at four frigates in total. A so-called "A-letter", a report from our Government to Parliament gives the rough outline of these frigates; they are multi-purpose frigates with a focus on anti-submarine warfare (ASW). They should also feature new forms of propulsion and new weapon systems like high-energy weapons. We expect the specific requirements to come out in the next six to nine months.

ESD: What about submarines?

DSNS: When it comes to submarines, the Netherlands has four unique WALRUS class boats in service. It is important to understand why we are in this programme. The WALRUS class is an ocean-going submarine design, and the four boats will undergo an extensive midlife update in the Netherlands. The WALRUS submarine is designed to support expeditionary operations which are important within the NATO framework. In fact, they might become even more important in the near future. Up until recently, we thought that maritime developments were more headed toward the littorals, but now developments in Russia, China, and India lead us back to the blue water domain. This is why the expeditionary aspect is still important. Secondly, because of that midlife update we have retained considerable submarine expertise; I would say that 80% of the expertise is still in the Netherlands.

And finally, as with the frigates, the submarine project will be designed as a launching customer project to allow for the generation of export potential.

Are we competing with Norway and Germany? I think they are just another ball game. For good reasons, these two nations have focused the operational concept of their cooperation on submarines with a more littoral alignment. According to our market analysis, we consider it necessary to offer a more expedition-oriented alternative. This is why we work exclusively with SAAB Kockums



Different variants of the SIGMA design have been exported to Indonesia, Morocco and Mexico.

ESD: The Netherlands has embarked on an important cooperation programme with Belgium for frigates and MCMV. What is the current status and what constitutes the basis for this cooperative effort?

DSNS: The cooperation between Belgium and the Netherlands is a good example of how medium-sized nations in Europe can successfully cooperate in procurement. I think this cooperation is worth being noticed in Europe because it is lean, efficient and focused on identical requirements. The Netherlands and Belgium have signed a joint collective agreement on the provision of frigates and MCMVs with a joint Letter of Intent and two MoUs. This very close and strategic cooperation pattern is called "Belgisch-Nederlandse samenwerking" (Belgian-Dutch cooperation - BENESAM). It has been in existence for more than forty years and reaches into every vein of our navies. But it does not only mean identical material; we have the same M frigates, also built by Damen, we have the same MCMVs, and we also share training, logistics, operation and apprentice training. For example, the knowledge base of Dutch and Belgian MCM forces is brought together at the Eguermin Mine Action School (Ecole

about the same time. We expect further steps in the months ahead.

The frigate programme provides for the joint replacement of the four M Class frigates by two frigates for Belgium and two for the Netherlands. As an OEM in the Netherlands, we are able to offer all types of high-end frigates and work directly with the Dutch Naval Cluster and the customer to arrive at a so-called project definition. Once in the lead, we will go for an engineering solution in close cooperation with the Dutch Defence Materiel Organisation as the customer. This will enable us to build these four ships.

As expressed in the Letter of Intent and the Memoranda of Understanding, Belgium will follow the Netherlands. This model of a launching customer project is vital for us as it provides both future-proof and innovative solutions to our domestic customer, the Royal Netherlands Navy, but it also offers us the means to turn these innovations into export lines. As a private company we survive by exporting our products; we do not get government support like some of our competitors. This is why we need to have the best project when it comes to lean production, efficient pricing and other contractual issues. Such export lines frequently



from Sweden and for three reasons:

First, because of their COLLINS class programme for the RAN. SAAB Kockums has a similar expedition-oriented focus and knowledge of the operational concept of the Dutch submarine service; they have a larger submarine sailing around in Australia with blue-water tasking.

Secondly, it is very important for us to keep our OEM cluster alive. Our self-sustainable innovative cluster works very well; we are lean, we are quick and, given the limited budgets of our own navy, for example, we can provide in-budget solutions. If we want to maintain the capabilities, we need to find a balanced partner. Thus, we are looking to cooperate with a medium-sized nation that has a similar approach, and Sweden has an impressive OEM base; just look at its car production, or other military activities such as submarines, armoured vehicles, or even fighters. Sweden is a real engineering powerhouse. When it comes to size and relations, SAAB Kockums fits very well into the Dutch naval cluster, and they offer us deep and integrative cooperation. That's why we will cooperate exclusively with SAAB Kockums; we will not only build the boat together but will also design it, engineer it, procure and manage it together – a real 50:50 deal.

SAAB Kockums will bring in the skills that we lack. At the moment, they are using this knowledge in support of two current programmes: Firstly, in the midlife update of the GOTLAND, which is a big de-risker and is really going well, and secondly, in the construction of the most modern diesel-electric submarine in Europe, the A-26.

As a team, we both can gather knowledge from these programmes in a risk-controlled manner: we are integrating the new developments into our own common design for the Netherlands MoD. That is why SAAB Kockums is a very important partner. We need development, we need intellectual property on knowledge and on design; this is how we can survive in exports.

And finally, SAAB Kockums as the designer and DSNS as the co-designer are complementary knowledge-wise when it comes to procurement, management, design and engineering. When it comes to building and operational project management and integration, we will act as the builder and SAAB will act as the co-builder. It is a perfectly balanced cooperation, with a lot of Dutch content, which allows us to develop the knowledge and the capability to sustain the boat over its entire lifecycle in the Netherlands. This strategic capability will make our Navy and the Defence Materiel Organisation completely independent. This is why cooperating with SAAB is so

important and we hope we can explain this to the Dutch Government.

The Government is currently examining all offers in response to the so-called market monitoring and we expect it to decide in the coming months what to do next. Will they continue with all parties or select some? Much has been rumoured, but nothing is official.



At IndoDefence 2018 Damen presented its OMEGA design of a next generation medium-size frigate.

ESD: At IndoDefence 2018, a tri service defence exposition in Jakarta, Indonesia, Damen presented the new 6,000 tonnes class OMEGA frigate design. What are the characteristics of this project?

DSNS: Generally, when looking at the OMEGA design, we see a growing demand for slightly larger frigates offering more modularity, more growth potential to add extra systems, for example, unmanned systems and which offer capabilities which might relate to new effectors like high-energy weapons, or new sensors, with a reduced radar cross-section, and so on. We feel that it is time for a larger concept that offers more opportunities to integrate the next generation of effectors, radars and technology. We see the demand from left and right, for example, from South America where some nations consider larger frigates than those they currently have in service. Many nations still operate the earlier 1980s and 1990s frigates which at that time did not exceed 3,000 tonnes. To improve seaworthiness, sustainability and other factors, many navies are now looking for larger platforms. So, this could be the solution.

ESD: The MKS180 is an important project for the German Navy. What is your share?

DSNS: Firstly, the German Government has called for an open European tender, and of course we can offer the German Government a future-proof frigate. As a trustworthy partner in Europe, we are responding to BAANBW's very extensive requirements profile in order to offer the German Ministry of Defence the optimal frigate, if required. This pro-

gramme requires a maximum of German content and we achieve this in all areas of competence, as already mentioned. This is very important to understand, because some people reject our offer as a Dutch offer, although it is not. With Blohm&Voss, owned by Lürssen, we have a strong partner who has many suppliers in Germany, which allows us to realise this programme as a German programme. Our participation is actually quite limited. Not only is the entire construction carried out on the premises of Blohm&Voss, we also involve our German partners in the engineering, procurement, etc. We will carry out this project together and in genuine cooperation. That is very important! The project is as German as possible, as we fully understand that the extensive funds that Germany provides for the realisation of this project for the German Navy should also strengthen the German naval cluster. And that is convenient for us because that is how we operate.

ESD: Thank you for the interview.

The interview was conducted by Hans Uwe Mergener.

Cyber Defence: NATO's Challenges

Joris Verbeurgt

With our societies increasingly dependent on modern information technologies, rapidly evolving cyber threats pose a growing threat. NATO will have to find a response.

Since the 1990s, billions of people worldwide have been using information and communication technologies (ICT). The Internet has evolved from a simple information exchange platform to the backbone of modern economies and societies. The impact of ICT on our personal, social and pro-

devices by various means of malicious acts, usually originating from an anonymous source that either steals, alters, or destroys a specified target by hacking into a susceptible system", are more common than we think. Many of these attackers use advanced persistent threats (APTs) as their modus oper-

plugin. This advanced cyber espionage campaign was aimed at diplomatic, governmental and scientific research institutions worldwide. It was never revealed who was behind these attacks.

Destructive Attacks

A second category of attacks are "destructive attacks" – attacks aimed at harming the target organisation. Examples are the malware "Wiper", which deleted information from the hard disks of Iranian oil companies in 2011. The modular computer virus "Shamoon", a malicious phishing email that entered Saudi gasoline company Aramco in 2012, caused the company to spend a week restoring its services. When it comes to defense, the best known malicious computer worm is "Stuxnet". It was allegedly designed by the US and Israel to sabotage Iran's nuclear programme and cause a series of "unfortunate accidents". It was discovered in 2010 and has since emerged in various forms and shapes.

Cyberwarfare

A third category of cyberattacks is labelled 'cyberwarfare': politically motivated destructive attacks aimed at sabotage and espionage. Some examples are the 2007 cyberattacks on Estonia, targeting government and commercial institutions. Other cases of cyberwarfare took place in Asia: in July 2009, major government, news media and financial websites in South Korea and the USA fell victim to a series of coordinated cyberattacks, involving a 'botnet' or a large number of hijacked computers that maliciously caused a server overload due to the influx of data. Between 50.000 and 166.000 computers were hijacked during the attack, with a majority located in South Korea. The timing of the attacks, coinciding with a North Korean short-range ballistic missile test, made researchers to believe that North Korea was the source of the attack, although no substantial evidence was provided for this claim. In 2010, rivalry between South Korea and Japan in female figure ice skating at the Vancouver Winter Olympics,



Photo: US Army

In 2017, all of the 41 Cyber Mission Force teams of the US Army Cyber Command achieved full operational capability. Depicted is the 780th Military Intelligence Brigade operations center at Fort Meade, Md.

fessional lives is enormous, and the benefits of Internet connectivity and the opportunities it offers to individuals and businesses are obvious. But there are two sides to every coin: While the confidence of our societies in digital infrastructure is growing exponentially, technology remains inherently vulnerable. The rapidly evolving cyber threats challenge the confidentiality, integrity and availability of ICT infrastructures and can lead to disasters of unknown magnitude.

To understand the challenges NATO is facing in terms of cyber defence, it is necessary to first address the various attacks and threats in cyberspace.

Cyberattacks

Cyberattacks, defined as "any type of offensive manoeuvre employed by individuals or whole organisations that target computer information systems, infrastructures, computer networks, and/or personal computer

andi to stealthily enter networks or systems and remain undetected for years.

A cyberattack can take many shapes and forms. Based on the source, the target and the intended damage, cyberattacks can be divided in a number of broad categories.

Indiscriminate Cyberattacks

The first category are "arbitrary attacks" – far-reaching, global attacks that do not distinguish between governments and businesses. A well-known example of an undifferentiated attack is the Red October cyber espionage malware programme, which was discovered in 2012. "Red October" was operated worldwide for five years before it was discovered and transmitted information ranging from diplomatic secrets to personal information. The malware was installed by email with attached documents programmed to exploit vulnerabilities in Microsoft Word, Excel and the Java browser

triggered a cyberwar between "netizens" (a contraction of (inter)net and citizens) from both countries. Other cyberattacks occurred during the Russo-Georgian War in 2008 and against Iranian nuclear facilities in 2006: President Bush then launched one of the first known uses of offensive cyberweapons when he ordered the execution of Operation Olympic Games, targeting the Iranian nuclear facility at Natanz. Bush ordered the operation since he believed that it was the only way to prevent Israel from striking the facility with conventional weapons.

Cyberespionage

Other categories of cyberattacks involve government espionage (stealing information from/about government organisations) and corporate espionage (stealing data from corporations related to proprietary methods or emerging products/services). A well-known example of government espionage is the massive spying by the US on many countries, including allies, as revealed by Edward Snowden. The disclosure of the fact that the National Security Agency (NSA) also spied on Germany's Chancellor Angela Merkel, made news headlines all over the world and caused a diplomatic

incident between the two countries. With 'Titan Rain', a series of coordinated attacks on American computer systems in 2003, hackers gained access to sensitive information on the computers of US defence contractors like Lockheed Martin, Sandia National Laboratories, Redstone Arsenal and NASA. The attackers were able to hide their identity, but it is believed that this government-inspired espionage originated in China. An example of a corporate espionage cyberattack is 'Operation Aurora', a series of cyberattacks in 2009 conducted from Beijing that targeted dozens of organisations, such as Adobe, Juniper Networks, Yahoo, Symantec, Morgan Stanley and Dow Chemical. The perpetrators had ties to the Chinese Army and tried to gain access to these high tech, security and defence contractor companies, and possibly tried to modify source code repositories.

Internet (H)ac(k)tivism

Another cyberattack category is "internet activism" (also called "hacktivism"), the use of technology to promote a political agenda or social change, often related to free speech, human rights or freedom of information networks. A famous hacktivist

is Julian Assange, the man behind the non-profit organisation Wikileaks. In 2010, this whistleblowing organisation published more than 90.000 documents on the wars in Afghanistan and in Iraq. Perhaps the most well known hacktivist group is "Anonymous" which has been very active in the last decade. It attacked the Scientology Church in 2008 and with Operation Payback, it attacked high-profile opponents of internet piracy like the Motion Picture Association of America and the British Phonographic Industry. Law firms, politicians like Sarah Palin and Joseph Lieberman and financial services providers like Mastercard, Visa and Paypal were also hacked by Anonymous. Anonymous also declared war on ISIS after the 2015 Paris terror attacks and in February 2017, it took down more than 10.000 child pornography sites on the Dark Web.

Other categories in cyberattacks are: stealing e-mail addresses and login credentials for specific web resources, stealing credit card and financial data, and stealing medical data.

Soft and Hard Threats

From a national security standpoint, cyberattacks present a multitude of threats, of

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The NATO Cooperative Cyber Defence Centre of Excellence is a multinational and interdisciplinary hub of cyber defence expertise. It hosts the annual CyCon International Conference on Cyber Conflict.

which espionage, sabotage, propaganda and economic disruption are the most important types.

Cyberespionage

Cyberespionage, or cyberspying, is 'the use of computer networks to gain illicit access to confidential information, typically that held by a government or other organisation'. The 'soft' threat of espionage, including cyberespionage, is not considered an act of war since all major powers use it. However, espionage incidents can cause serious tensions between nations. Successful cyberespionage operations can give the spying country a considerable advantage over the country that was spied on: all powers spend large sums of money on finding out what the adversary is doing and to what intent. A successful cyberespionage operation in the field of defence technology can save the spying country a lot of money on research and development, or bridge a technological gap in a short time span that otherwise would have taken years. The attackers use cyberespionage for economic, political, or military gain. They are deliberately recruited and are highly valued for their technical know-how. China has several cyberespionage battalions, of which Unit 61398 is the most controversial one since it is believed to be responsible for several attacks on the US. The US, Russia and North Korea also have units within the armed forces and the security forces that specialise in cyberspying.

Cyberpropaganda

Cyberpropaganda, defined as "the use of information technologies to manipulate an event or influence public perception toward a certain point of view", is a second 'soft' form of cyberattacks. It is a form of psychological warfare that uses social media, fake news websites and other digital means with the aim of de-legitimising the political and social system of a country. Cyber propagandists deliberately attempt to shape per-

ceptions, manipulate emotions and direct the behaviour of large internet audiences to achieve a response that furthers the intent of the propagandist. Cyberpropaganda can also be used to influence elections in democratic countries. A case currently under investigation by Special Counsel Robert Mueller is that of the presumed Russian attempt to manipulate the 2016 US presidential elections. The theft and leaking of Hillary Clinton e-mails while she was Secretary of State under President Obama, are a good illustration of cyberespionage and cyberpropaganda at once.

But cyberattacks are not per definition 'soft' threats. They also consist of 'hard' threats and can be used to support traditional warfare.

Cybersabotage

Cybersabotage or "destructive hacking" can be defined as "the deliberate and malicious use of cyber means to disrupt the normal processes and functions of cyber infrastructure or to destroy or damage equipment or information". Cybersabotage can take place when contaminated hardware or software are purposefully installed during the manufacturing and installation process or are delivered over the internet. Not only military systems like computers and satellites can be targeted. Since power, water, fuel, communications and transportation infrastructure are all connected to the internet and with cyberspace, they are all vulnerable to disruption. Potential targets also include power grids, trains, or the stock market. The military and civilian spheres of a nation are susceptible to malicious interception. In cybersabotage, a denial-of-service (DoS) attack is the most common attack: an attempt to make a machine or network resource unavailable to its intended users. A DoS, when properly executed, can be as devastating as a physical attack against the infrastructure. Coordinated DoS attacks can lead to large-scale economic disruptions. In 2017, Ukraine and the British National Health Service became victims of DoS attacks result-

ing in financial losses in the millions. Only recently, the controversial president of Venezuela, Nicolás Maduro, accused the USA of sabotaging the Venezuelan power grid with cyber attacks, which led to an almost complete power failure in the afflicted country.

NATO and Cyber Defence

Since cyberattacks pose a genuine threat to national security and to the stability of the international system, states have developed cyber defence strategies and established organisations within their defence and intelligence departments to counter cyber attacks. Of course, NATO could not fall behind. The first time that cyber defence was on the Alliance's agenda was at the Prague Summit in 2002. The need to improve the protection of communications systems was reaffirmed at the 2006 Riga Summit, but it was the major cyber attack on NATO ally Estonia a year later that triggered NATO cyber defence action. First, a NATO Cooperative Cyber Defence Centre of Excellence was established in Tallinn in Estonia. Nearby, at the NATO Cyber Range in Tartu, cyber experts can develop their capabilities through realistic exercises. As of January 2018, CCDCOE is responsible for identifying and coordinating education and training in cyber defence for all NATO bodies across the Alliance. Secondly, the first NATO Policy on Cyber Defence was approved in January 2008 and at the Lisbon Summit in 2010, a new Strategic Concept was adopted. An in-depth NATO cyber policy was to be developed, as well as an action plan to implement it, both of which were approved in June 2011 by the NATO defence ministers. A year later, cyber defence was integrated into the NATO Defence Planning Process, in which relevant cyber defence requirements were identified and prioritised throughout the process. In 2012, at the Chicago Summit, the Allies reaffirmed their commitment to bring all of NATO's networks under centralised protection and in The Hague (in the Netherlands), the NATO Communication and Information Agency (NCIA) was established to be in the frontlines against cyberattacks. In close co-operation with governments, the industry and the academic world, the NCIA provides resilient Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) systems to acquire, deploy and defend NATO's communications systems. A Cyber Security Service Line (NCIACSSL) was established for the planning and execution of life cycle management activities. It also provides specialised cyber security services covering the spectrum of scientific, technical, acquisition, operational, maintenance and repair



Photo: NATO CCDCOE

In August 2018, about 400 computer experts participated in a major cyber security drill called “Operation Locked Shield” at Estonia’s NATO Cyber CoE as part of NATO’s efforts to upgrade its capability to counter potentially debilitating hacker attacks.

support throughout the lifecycle of NATO information communications and technology. The Wales Summit in 2014 was another milestone in developing NATO’s cyber defence capabilities, when a new Cyber Defence Policy was endorsed which aimed at boosting cooperation with the private sector and the NATO Industry Cyber Partnership (NICP) was established. In 2016, NATO and the EU concluded a Technical Arrangement (TA) on Cyber Defence to help both organisations to prevent and respond to cyberattacks. The TA provides a framework for exchanging information and sharing best practices between the emergency response teams of the 200 strong NATO Computer Incident Response Capability (NCIRC) that was established within the NCIA and the Computer Emergency Response Team of the EU (CERT-EU). At the Warsaw Summit, the NATO Allies recognised cyberspace as a domain on its own, in addition to the existing operational domains of air, sea and land. Other updates, initiatives and pledges followed suit, and on 8 November 2017, the defence ministers created a new Cyberspace Operations Centre to be established in Belgium. The Centre will provide situational awareness and coordination of NATO operational activity within cyberspace. To do so, NATO can make use of national cyber capabilities for its missions and operations. Finally, Allies took stock of their progress to enhance national resilience through the Cyber Defence Pledge. Although each Ally remains responsible for its own cyber defence, NATO supports its members in boosting these defences by sharing real-time information about threats and by exchanging best practices on handling cyberthreats. In addition, NATO maintains rapid-reaction cyber defence teams that can be sent to help Allies in addressing cyber challenges. It also develops targets for Allies to facilitate a common approach to their cyber defence capabilities; and invests in education, training and exercises, such as Cyber Coalition, one of the largest cyber defence exercises in the world.

NATO’s Challenges

Cyber threats continue to evolve. NATO networks, covering over 60 different locations and serving more than 100,000 people, have experienced increasing cyber attacks over the past decade. NATO’s cyber defence systems register suspicious events on a daily basis, ranging from simple attempts to technologically sophisticated attacks on NATO’s IT infrastructure. Most of these attacks are detected and handled automatically, while others require expert analysis and response. NATO, in close cooperation with the EU and industry, is already making big efforts in the field of cyber defence. But the following challenges remain.

In cyberspace, there is no clear division between the military and the civilian realm. Cyberattacks on civilian targets can be as devastating as a physical attack. Although the outcome of the cyberattack can be military, cyber defence cannot be achieved through military means alone. Many more actors are involved, like civilian governments, private industry and individuals (think of Bill Gates or Marc Zuckerberg, or Assange and Snowden). This challenge is already tackled by NATO, but experts are just beginning to understand the complexity of cyberspace and the consequences of worldwide interconnectivity and dependence on ICT. A lot more has to be done, in close cooperation with the industry and academia.

Another challenge for NATO is to determine who the adversary is: most hostile cyber activity is below the threshold of armed conflict. Malicious cyber activity can come from state actors or non-state actors (terrorist organisations, hacktivists or individuals) or state actors disguised as non-state actors. It is difficult (even dangerous) to determine a proportionate and effective response if the actual source of the threat is unknown or uncertain.

A third challenge for NATO is to align the various national cyber defence strategies that individual Allies have developed. These strategies are based on national assumptions, preferences, and technological and

industrial singularities; it is a real challenge to design a concrete NATO strategy and action plan for cyber defence that takes into account all these national interests.

Which brings us to the fourth challenge: the legal and judicial aspects of a NATO-led cyber defence. NATO’s three essential core tasks – collective defence (Article 5), crisis management and cooperative security – should also be executed in cyberspace. However, in cyberspace there are many more stakeholders, myriad threat actors and a lot of actions in grey space. Questions that need an answer are, for example, the relationship between national capabilities and sovereignty, and the authority of NATO. The efforts undertaken by NATO to mainstream cybersecurity activities have thus far proven insufficient to fully address the growing cyberthreat. And what about privacy regulations? NATO is forbidden to target the citizens of its member states, but does this also apply to cyberspace? Does Article 5 apply to cyberattacks, and what should be the response? What is the role of international law in cyberspace and with regard to defensive and offensive cyberweapons? There is no coherent international legal framework, due to the technicality of the cyber defence issues and, perhaps, because major powers like the US, Russia and China prefer to operate in ambiguity. And what about the law of armed conflict, telecommunications or satellite law, and criminal law, which are all affected by cyber defence measures? What will be the actual or legal responsibility of NATO? These questions are a serious challenge for NATO in the near future.

Challenge number five is the rapid pace of change in cyberspace. Serious investments in information gathering, human talent and technical capabilities are necessary to keep abreast of the threats. Cyber technology continues to evolve and the vulnerability to attacks increases as a greater range and number of devices connect to each other and to the internet. More cooperation with the industry and civilian actors is required to prepare for the future cyber battlefield where there will be no line between the military and the civilian world.

Conclusion

NATO has already come a long way on cyber defence issues and is doing much to improve the Alliance’s cyber defence capabilities. At the same time, the ever-evolving cyber environment and the ongoing evolution of threats require NATO to step up its investment and cooperation with industry and civilian actors. While the foundation stone has been laid, the building itself is still under construction. ■

Current Threats in the Cyber World

Petr Jirásek



Photo: Petr Jirásek

Petr Jirásek is Cyber Security & IT Adviser and Chairman of the Czech Cyber Security Working Group.

We are living in fascinating times we could not even imagine just a few years ago. And we enjoy freedom: We can buy products in our cities that were made on the other side of the world. We can travel almost anytime and anywhere, we can communicate almost free of charge with anyone on the planet, often with people we don't even know and who have a false identity. We live predominantly in a virtual reality full of social networks, information technologies and now even artificial intelligence. On the one hand, we do our best to protect our privacy, and on the other hand, we frequently put it to the mercy of fate in digital space. We are mortally addicted to modern technologies. We are so addicted that we cannot imagine life without electricity, the internet, computers or smartphones.

For the most part, we have no understanding of this new "modern" environment; we are fascinated lay people who admire the perfection and beauty of the environment. And we are unwilling to be aware of the dangers of digital space (cyberspace). After all, it is only virtual reality.

The biggest danger is therefore our addiction, inadequate education and poor understanding of the opportunities and risks that modern technologies involve. For thousands of years, we have learned to live in the real world and to behave appropriately. Yet the digital world has only been around for a few decades and we believe that nothing bad can happen. We are becoming more and more dependent and we often lack critical thinking and common sense – "The main thing is that it makes our lives easier." We are often unable to decide and distinguish what is meaningful and contributes to our lives and what is just a "gadget" that we can skip.

An Unacceptable Risk

We may be a man on the street, a businessman, a large company or sometimes even the state, and we are all too quick to give up our technological sovereignty. Quite often, we don't even mind giving up control of supply chain security for our critical systems and applications. And that's usually the case when the applications are developed by unknown programmers and distributed to different public data repositories ("The main thing is, I can install it on my smartphone..."), or when we're dealing with large supply chains

for the critical systems that provide security for the state where it is pretty obvious that this is an unacceptable risk.

For decades, our developers have been given the possibility to roll out systems and applications without guarantees, without responsibility, without supervision. We are unwilling to take responsibility, even in part, for the development, reliability and quality of such systems. Still, we are always surprised when our electronic systems prove vulnerable and imperfect.

On the other hand, we believe that standards, regulations and laws will solve all problems. If one does not have many years of experience, such standards are good prerequisites, but certainly not a solution. Finally, in road transport we have many legal standards and a traffic system with modern regulations, driving licences, TÜV certificates, traffic signs, technical and police checks and many other aspects, including preventive and repressive measures. Nevertheless, year after year we have millions of road accidents and deaths on the roads and many court cases. What then leads us to conclude that by creating laws, regulations and technical certifications in the cyber area, we can solve all the problems of the digital world?

Many experts believe that it would be a good solution to consistently secure critical processes and important information systems and even to separate them from the outside world. The economies of our countries, however, are mainly driven by small and medium-sized enterprises and not by critical systems. In the European Union alone, SMEs account for more than half of GDP. We invest too little in education and general awareness. We offer too little help to small firms, which usually have neither many sensitisation opportunities nor the financial means to invest in security and especially cyber security (after all, it is not their core business). However, these companies are the pillars of our economies. Do we offer them enough help and opportunities to safely develop and run their businesses?

A Cultural Change

We don't have enough experts. But it is not only the experts who are missing, but also the IT-literate users, managers, lawyers, diplomats, members of science – simply the informed society. On the one hand, we should start shaping a younger, better-informed generation and do so at a tender age. Maybe in this way we can bring about cultural change and raise a generation of people who not only move easily through the virtual world, but can transform the virtual world for the good of society. On the other hand, we must also take care of our current employees and expand their knowledge and retrain them. Nonetheless, this learning process will take at least a generation.

Events in the cyber world may not be so visible and are certainly less tangible. However, the same laws apply here as in the real world. There are many risks and threats that exploit human and technological vulnerabilities. These cannot be completely eliminated, but we can minimise their impact. But this requires an active interest in our technology, an understanding of the principles and shortcomings, and, above all, not a thoughtless acceptance of what we encounter in cyberspace. Our world is teeming with daydreamers and cheaters. The biggest threat is then excessive trust and unwillingness to expand our knowledge and overcome the lack of critical thinking.

The European Air Transport Command

Tasks and Missions

Giulia Tilenni

Established in 2010 in Eindhoven to fill the gap European countries had in strategic transportation, the European Air Transport Command (EATC) has become a staple in European air transport, air-to-air refuelling, and medical evacuation.

The idea of establishing a joint air transport command in Europe dates back to 1999, when France and Germany decided to jointly fill the capability gap in air transportation identified by the EU and NATO. The basic idea was to establish a multinational command structure with an operational and functional authority to optimise the scarce national resources in this domain thanks to pooling and sharing. Belgium

the Command's achievements exceeded the initial mission of providing enhanced air transport capabilities to its members, because EATC rapidly developed highly relevant capacities in the whole spectrum of air mobility operations. Thanks to pooling and sharing of aerial assets and integrating operational responsibilities, the Command pursues air-to-air refuelling (AAR), cargo and passengers transport, air and



Security and Defence Policy). However, its assets could contribute to the EU-led civil and military missions organised under article 42.3 of the European Union Treaty. According to this article, multinational forces that have been jointly established by member states could be made available for CSDP's objectives.

All this considered, the idea of creating a European command dedicated to air transport missions was initially part of the European common defence architecture. The objective of "establishing a European air transport command to increase the number of readily deployable troops; and to enhance strategic sea lift capacity" was among the collective capability goals listed at the Helsinki European Council of December 1999, expected to pave the way for the implementation of a real European defence cooperation. The fulfilment of the so-called Headline Goal identified in the meeting conclusions and expected to be reached by 2003 should have allowed EU members to cover the Petersberg tasks, which defined the EU military role in crisis situations. Although these objectives are still far from being achieved, the fact that the establishment of a transport command was identified as a common need to satisfy at the European level reaffirms the ambition of EATC's missions, and explains the importance of the Command's cooperation with other EU entities. Indeed, EATC's experience provides a great contribution to EU cooperative efforts in the defence domain thanks to the close collaboration with the European Defence Agency (EDA). For instance, part of EATC's personnel supports the daily activities of the European Tactical Airlift Centre inaugurated in Zaragoza in 2017, which serves



Photo: Jose Luiz Lezg / EATC

This Spanish A400M is part of the EATC fleet.

and the Netherlands first, and Italy, Luxembourg and Spain subsequently, decided to join the Command, which was formally established in its current structure in 2010. Thanks to EATC, a number of aerial assets from the seven member nations are operated under one command and according to a common standard of rules. Over time,

parachute dropping, and MEDEVAC missions. In addition to that, EATC works on harmonising processes and standardising procedures in order to ease interoperability among its members and to provide them with innovative solutions thanks to the application of best practice.

EATC's Connections with EU Defence

EATC has no formal connections with EU defence policies and structures, as it is not part of PESCO nor of the CSDP (Common

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as headquarters for the European Air Transport Fleet training programme. Moreover, EATC and EDA collaborate with OCCAR on harmonising procedures and certifications, for instance within the Single European Sky programme, but also in relation to in-service support for the A400M fleet to be assigned to EATC's command.

EATC: An Organisation Based on Three Pillars

In order to maximise the impact of integration on the efficiency and effectiveness of air transport missions organised by member states, EATC is organised around three divisions that constantly interact with one another: Operational, Functional, and Policy and Support divisions. This structure provides the functional and operational authority that the founding members wanted to give to the Command.

The Divisions

The two divisions, acting under the control of EATC's chief of staff Brigadier General Andreas Schick, are in charge of harmonising the doctrines and procedures of EATC-led missions and liaising with external entities, respectively.

The Functional Division

The Functional Division enables the promotion of shared values and harmonised doctrines, procedures and regulations in relation to employment, training and logistics. Training and exercise are at the core of EATC's activities, as they allow member nations to strengthen their cooperation and they maximise EATC's positive impact on their air transport activities. Since 2013, the Command has also worked on draft-



Photo: EATC

In the last ten years, EATC has airdropped 800,000 paratroopers.

ing common operation manuals in order to reach the highest possible level of interoperability among its aerial assets. For instance, when EATC was established each of the seven members worked in its national language and used its own procedures for passenger and cargo handling. Thanks to the use of EATC's Operational Manual (OM) and Ground Operation Manual (EGOM), which are periodically revised to remain compliant with the relevant operational environments, member countries have finally adopted English as the language used for their air transport-related activities, and have started working on the optimisation of their limited fleets of transport aircraft. The intensive training activities organised by EATC provide an important contribution to the maximisation of commonalities. The Command offers several professional training programmes in air refuelling (EART), disabled aircraft recovery (DART), and combined air terminal operations (CATO, CATT and ACATT). E-learning tools are also part of the training offer. The seven member nations also participate in broader European training activities, namely the European Tactical Air-lift Programme (ETAP). ETAP, which is open

to 11 European countries, consists of training activities concerning airlift (ETAP-T), crew members' missions (ETAP-C) and instructor pilots' tasks (ETAP-I). The organisation of a yearly symposium involving participants (ETAP-S) is also part of the framework. It allows discussion of existing procedures and lessons learned.

The Policy and Support Division

The Policy and Support Division provides broad-spectrum support to EATC's activities, such as mission analysis and reporting, and contributes to the development of innovative strategies to be implemented by the members. The ATARES cashless exchange system for air transport services provides an interesting example of the activities this Division is committed to. This system, which is in use among 28 NATO and EU countries, consists of services' exchanges calculated on the price of one C-130/C-160 flying hour. It allows users to optimise their aircraft load factor by reducing empty space and to make savings on outsourcing expenses, also providing additional training opportunities for crews. One of the strongest of ATARES' features is the fact that exchanges go beyond bilateral reciprocity, being extended to all the states that have adopted the system.

The Operational Division

The EATC consists of a 200-people-strong multinational and integrated team of experts, working 24/7 and carrying out about 60 missions per day. The Operational Division, which acts under the control of EATC's deputy commander Brigadier General Francesco Saverio Agresti, is in charge for running the five different phases of each mission cycle. On the behalf of member states, this division is responsible for planning, tasking, controlling, and intelligence gathering during peace and war times, as

Photo: EATC



An Italian Aeronautica Militare Boeing KC-767

well as for mission management, which is pursued thanks to MEAT (Management of European Air Transport). This dedicated tool is in-house developed multi-user software that has about 2,800 users. It is periodically adjusted to better serve member states' needs.

The Command's fleet operates from 12 bases in addition to the Eindhoven headquarters: Melsbroek (Belgium); Hohn, Wunstorf and Köln-Wahn (Germany); Luxembourg; Pisa and Pratica di Mare (Italy); Zaragoza and Getafe (Spain); Orléans, Evreux and Paris Charles de Gaulle (France). EATC's missions are carried out thanks to a 170-aircraft-strong fleet. The Command's aerial assets include the following models:

- Airbus C-295, CN-235, A310 MRTT, A310, A321, A340, A400M
- Boeing KC-767A
- Leonardo Velivoli C-27J SPARTAN
- Lockheed-Martin C-130H HERCULES and C-130J SUPER HERCULES
- Transall C-160
- Embraer 135/145
- FALCON 900
- Gulfstream IV
- McDonald Douglas KDC-10

Airbus A400M: EATC's Key Enabler

Since the beginning of the first deliveries in 2013, the Command has chosen the integration of A400M aircraft belonging to members as its lighthouse programme. In particular, the EATC is in charge of optimising the use and increasing the effectiveness of the Belgian, French, German, Luxembourg and Spanish A400M fleets, which are the result of one of the most important and ambitious European cooperative aerial programmes. To reach this objective, the Command has been working on defining concepts and manuals to maximise the impact that cooperation could have on the use of these aircraft in operational theatres. The A400M Atlas Common Concept (2013) and Doctrine (2016) are intended to guide users in pursuing cost savings thanks to a dedicated framework that includes procedures' standardisation and harmonisation. In particular, the Doctrine sets interoperability in the domains of command and control, communication and information systems, operations, logistics and training. EATC has also set the basis for enhancing cooperation among the whole A400M Operational Users group, with a particular focus on standardising relevant documents, sharing databases and information, and harmonising mission preparation and planning, as well as engineering practices.

In order to stress the European dimension of the A400M programme, EATC has signed several cooperation agreements with relevant European stakeholders and partners. This includes the A400 Interoperability Framework signed with the UK and the A400M Vision Paper jointly signed with OCCAR in 2016, which lists and analyses the crisis scenarios that could involve com-



Photo: EATC

**Major General Laurent Marboeuf,
Commander EATC.**

mon airlift capabilities. In 2018, EATC also signed a Letter of Intent with EDA and OCCAR aimed at using synergies to avoid duplications and maximise the efficiency of the A400M European fleet.

In the future, the Command is expected to increase its role in the ramp-up of the fleet. Today, EATC has operational control of the current 38-aircraft-strong fleet, being responsible for planning, tasking, controlling and reporting on missions on the behalf of users. In the future, the Command will work on pushing forward the whole fleet's interoperability (138 aircraft) according to its mandate. In the meantime, EATC will try to maximise interoperability and effectiveness in an attempt to fill the capability gap in the transportation sector and to reduce the negative impact that the delays in A400M deliveries had on users' aerial capabilities.

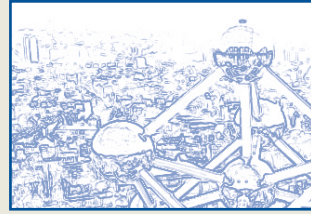
Results Achieved

Since its establishment, EATC's daily activities have been fulfilled according to integration, innovation and effectiveness, the three core values the Command is based on. In the last ten years, EATC's assets

reached approximately 400,000 flying hours and completed more than 67,000 missions. These include more than 2,300 AAR missions, the transport of 2.5 million passengers and 150,000 tonnes of cargo, the evacuation of 9,000 patients, and the airdrop of 800,000 paratroopers. In accordance with the objectives given to the Command when it was founded, EATC's activities provided a great contribution to the efficiency and effectiveness of member countries' strategic transportation. During the 2011 NATO-led operation Unified Protector, the Command helped out in filling the capability gap that European countries had to face, as it allowed maximum use of EATC members' scarce reliable aerial assets. Despite the Command's efforts, however, this operation demonstrated to what extent European countries were dependent on US AAR capabilities, which remained an indispensable support for European contributing countries during the whole mission.

Future Perspectives

In 2012, lessons learned from that operation pushed European states to address their capabilities shortfalls in the AAR domain thanks to pooling and sharing and according to four pillars – short-term gap filling, optimisation of existing assets and organisations, A400M tanker kits and strategic tanker capabilities. As lead of the second pillar, the EATC is in charge for seeking innovative procedures to further enhance its members' AAR capabilities, and more generally for the whole spectrum of air mobility tasks. EATC's expertise and employment of best practice are used to make pooling and sharing increasingly effective, and to apply the Command's know-how to the operational use of the newest assets joining the fleet. In the near future, EATC will have a central role in the establishment of binational and multinational fleets, namely the multinational A330 MRTT fleet based in Eindhoven and Köln-Wahn and involving the German, Belgian, Dutch, Luxembourg and Norwegian assets; the Belgian-Luxembourg A400M fleet based in Melsbroek and the Franco-German C130J fleet in Evreux. To remain at the forefront of European AAR capabilities, the Command's fleet is expected to triple in the coming years thanks to the deliveries of A400Ms and KC-130Js. To beef this up, EATC will become the major European force provider, and its large operational options will finally reinforce the operational capabilities of member countries, allowing them to increase their strategic independence in this domain. ■



President Trump and NATO: a Mid-Term Review *Part 2*

Joris Verbeurgt

President Trump has been in office for two years now. In the previous Brussels Backdrop, we covered President Trump as a person and his statements on NATO before becoming president. In this Brussels Backdrop, we will assess US foreign policy under Trump and his course of action towards NATO and the European allies.



Photo: White House

President Trump and NATO Secretary Stoltenberg at NATO Headquarters in Brussels, 11 July 2018.

Is NATO Obsolete?

During his presidential campaign, Trump promised to tackle the free-riding of some European allies and to make fair burden sharing a cornerstone of his NATO policy. He also complained that NATO was not enough involved in counterterrorism and in defending Ukraine. In an interview with *The Times* on 16 January 2016, Trump said that the West should trust Putin and that 'NATO was obsolete'. He invited British Prime Minister May to the White House

and declared that other European countries would follow the British example and leave the EU.

Ten days later, May visited Trump after his inauguration. In their joint press conference, it was May who confirmed Trump's "100% commitment toward NATO". The president himself kept quiet which worried the European Allies, especially Poland and the Baltic States. To reassure them, Trump reiterated the US support for NATO in a phone call he made with NATO Secretary General Stoltenberg on 5 February. A month later, Trump tweeted that "Germany owes vast sums of money to NATO" and that "the United States must be paid more for the powerful, and very expensive, defence it provides to Germany". Germany's Minister of Defence, Ursula von der Leyen, quickly rebuked Trump's allegations and said that "there is no debt account at NATO" and that America's military commitment to NATO was not a "favour to Europe" but a mutually beneficial arrangement, because keeping Europe "whole and free" was key to US interests.

It's all about Money

On 25 and 26 May 2017, at the new NATO Headquarters in Brussels, Trump criticised member states for their levels of defence spending, but at the same time he received a commitment from NATO to formally join the international anti-ISIS coalition. However, he broke with diplomatic rules when he publicly castigated 23 of 28 NATO members for failing to spend enough on defence, placing an unfair burden on US taxpayers. Once more, Trump's statements alarmed European Allies, who openly questioned America's commitment to Article 5 of the NATO charter regarding the mutual obligation for common defence.

On 15 December, after Trump had signed the National Defense Authorization Act's 2018 budget, providing US\$25M dollars for road-based cruise missile technology, in violation of the 1987 and 1988 Intermediate-Range Nuclear Forces Treaty with Russia, NATO released a statement in support of Trump's decision, stating that "full compliance with the INF Treaty is essential". Russia was blamed for breaking the Treaty first, and the Allies gave their full support to the American actions.

At a meeting of NATO Heads of State on 11 July 2018 in Brussels, Trump turned up late for the summit, with an agenda that would stun the Allies. First, he accused Germany of not spending enough money on defence and of being a "captive" of Russia by becoming dependent on Russian energy supplies. Later on, he made a surprise demand for members to raise their defence spending to 4% of GDP, even though most members don't even spend the agreed 2% on their defence budget. Then he left May, Merkel and Macron waiting at a meeting about Georgia and Afghanistan and when he finally arrived, he went on a diplomatic rampage. Trump dispensed with the usual diplomatic niceties and charged forward, saying his predecessors in the White House had pushed for an increase by Europeans on defence spending and he was not going to put up with it. He said that the European Allies had to raise spending by January 2019, or the United States would leave NATO, thus abandoning the alliance that had been the cornerstone of its military strategy for 69 years. The ultimatum set by Trump that all European Allies had to reach NATO's defence spending target that same year, urged NATO Secretary General Stoltenberg to call an emergency meeting. However, the meeting broke up, without Stoltenberg or any of the other European leaders offering a single concession. At the press conference



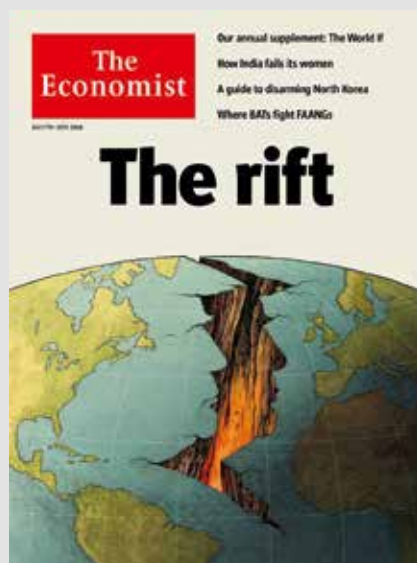
that was held later, Trump hailed the summit as a success and praised NATO. He further insisted that his relationship with other NATO leaders was good and – though other European leaders later disputed this – that they had agreed to significant increases in spending.

Trump and Macron: a Bromance Gone Wrong

Under Trump, US relations with Germany are at a low not seen since the Second World War. With the second biggest power of the EU, France, relations are also troubled. Although Trump and Macron at first found themselves in what was described as a “bromance”, tensions rose high at several occasions. In November 2018, Trump made some remarkable tweets about Macron and France. In a radio interview, Macron had appeared to cast the United States as a threat. Trump rejected Macron’s warnings against the threat of nationalism, delivered during an emotional ceremony in Paris attended by scores of world leaders. When pointing to Macron’s recent comments about Europe’s need to protect itself, he tweeted “it was Germany in World Wars One & Two - How did that work out for France? They were starting to learn German in Paris before the US came along. Pay for NATO or not!” But the final blow to Franco-American relations was given when Trump unilaterally decided on 19 December, in total neglect of France’s strategy and interests in the region, to withdraw American forces from Syria.

An article that was published in the New York Times on 14 January 2019 again set off alarm bells in the NATO Headquarters and in the capitals of Europe: apparently, Trump keeps saying in meetings, that NATO is costing the US too much money and that it would be better for the US to leave the Alliance. The official reaction from the White House, stating that the US valued NATO and was strongly committed to the Alliance, did little to reassure NATO diplomats. Again, fears were raised that the US would go its own way if the Europeans did not comply. When Defence Secretary Pompeo refused to deny the statements made in the NYT article and refused to guarantee that the US would comply with the Article 5 obligations, panic took hold among NATO mem-

bers; everyone believed that Trump would announce in his State of the Union on 5 February that the US would withdraw from NATO. Stoltenberg rushed to Washington in an attempt to smooth things over. He did not get to meet the president, but met with Pompeo instead. In an interview with



A mid-July 2018 TIME magazine cover illustrated the rift between the US and its European NATO allies.

Fox News, Trump’s preferred TV channel, Stoltenberg stressed that the European Allies had understood Trump’s message and that they would continue to act accordingly. Since 2016, the European member states and Canada had already invested US\$41Bn on defence and by 2020, that figure would rise to US\$100Bn. Soon after, Trump tweeted: “Jens Stoltenberg, NATO Secretary General, just stated that because of me NATO has been able to raise far more money than ever before from its members after many years of decline. It’s called burden sharing. Also, more united. Dems & Fake News like to portray the opposite!”

Conclusion

Now, what to think of Trump’s parcours with NATO and the European Allies after two years of presidency? The first thing that catches the eye is that Trump is a complete political outsider to the

world of international politics and diplomacy. He was a New York businessman and a TV celebrity with a reputation of being uncouth and telling it as it is. This attitude won him great popularity with many Americans, and finally also the presidency. If Trump is as narcissistic as many believe, then being popular with his voters is the most important thing on his mind. What else does he have to win or lose? He is in his seventies and he is a prominent billionaire and holds the most important office in the world. The ‘American dream’ really came true for him. As an outsider, with few ties to the political and media establishment, he owes his position entirely to the American public. It is for his voters that Trump wants to deliver. He shares their dislike for Europeans and for liberals like Merkel and Macron and for diplomatic rules and established policies that are perceived as unfavourable towards the US. With his re-election coming up in less than two years, it is very likely that this will influence his political standpoints and actions in the near future (for example, the wall on the border with Mexico he insists on building).

There is a pattern to his moves: Trump first threatens to drop the Article 5 obligation, or else leave NATO, and then one of his staff softens the consequences. The panic his statements cause, are used for political gain for the US on the international scene: letting go of the INF Treaty, Europeans contributing more to the fight against ISIS, the retreat from Syria and above all, European Allies spending more money on defence. All these actions, including insulting European leaders, make him a great president in the eyes of his electorate. In other words: the president and his administration blow hot and cold at the same time. With regard to North Korea and to European defence spending, this strategy bore fruits. After all, Trump’s critique on Europe isn’t new: almost all presidents since Bush senior have asked for larger European contributions, in vain. Trump, with his non-conformistic approach, succeeded where his predecessors failed. As part of the deal, Trump accepts bad relations with European leaders like Merkel and Macron. There is no mutual sympathy anyway, and Trump is more focusing on the Pacific and China, believing that Europe is a power of the past.

Photo: Time

The NATO Strategic Communications Centre of Excellence

Linda Curika

Since its establishment in 2014, the NATO Strategic Communications Centre of Excellence (NATO StratCom COE) in Riga has developed into a knowledge hub in the ever-changing world of strategic communications. The Centre is a multinational organisation recognised by NATO.

The NATO Strategic Communications Centre of Excellence (NATO StratCom COE) is a multinational and NATO-accredited organisation. Its mis-

sion is to contribute to the Alliance's communication processes by providing comprehensive analysis, timely advice, and practical support. Besides research studies and training for governments on strategic communication, the NATO

StratCom COE has been developing significant expertise in countering hostile information activities by state and non-state actors.

StratCom COE is a diverse group of international experts.

Since its establishment in 2014, NATO StratCom COE in Riga has become a hub of knowledge in the ever-changing world of strategic communications. Strategic communication plays an important role for NATO countries, and the Centre's mission is to support countries in their Strategic Communications efforts by bringing together military, academic, business and government knowledge.

Arctic Narratives and Political Values

Recently, NATO StratCom COE published a report "Arctic Narratives and Political Values: Canada, Russia and China in the High North" that provides an analysis of the Arctic-related press statements, official policy doctrine and speeches that have been made publicly available in English since 2012. Researchers have analysed how countries build their arctic identities, promoting a shared national identity in the Arctic, connecting domestic audiences to the region and forging an emotional and often romanticised connection towards it.

"Virtual Russian World in the Baltics"

The report "The Virtual Russian World in the Baltics", published in early 2018, concludes that Russia views the Baltic States – and their Russian-speaking populations – as key target groups that can be used as focal points to spread disruptive influence, reshape political and popular opinion, and reinforce misleading or false images and narratives. The main objective of this research report was to study the demographics, public posts, and behaviour patterns of Rus-



Photos/Graphic: NATO StratCom COE

Lithuanian President Dalia Grybauskaitė, US Senator John McCain and Latvian President Raimonds Vejonis giving a joint press conference after the inauguration of the NATO Stratcom CoE in Riga, Latvia, on 20 August 2015.

Author

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The NATO StratCom COE was initially founded by Latvia, Estonia, Germany, Italy, Lithuania, Poland, and the United Kingdom. The Netherlands, Finland, Sweden and Canada joined at a later stage. Additionally, France and Slovakia are finalising their joining procedures. Participants from the civilian and military, private and academic sector – aided by modern technologies and virtual tools for analysis, research, and decision-making – constitute our advanced capabilities. At the heart of the NATO

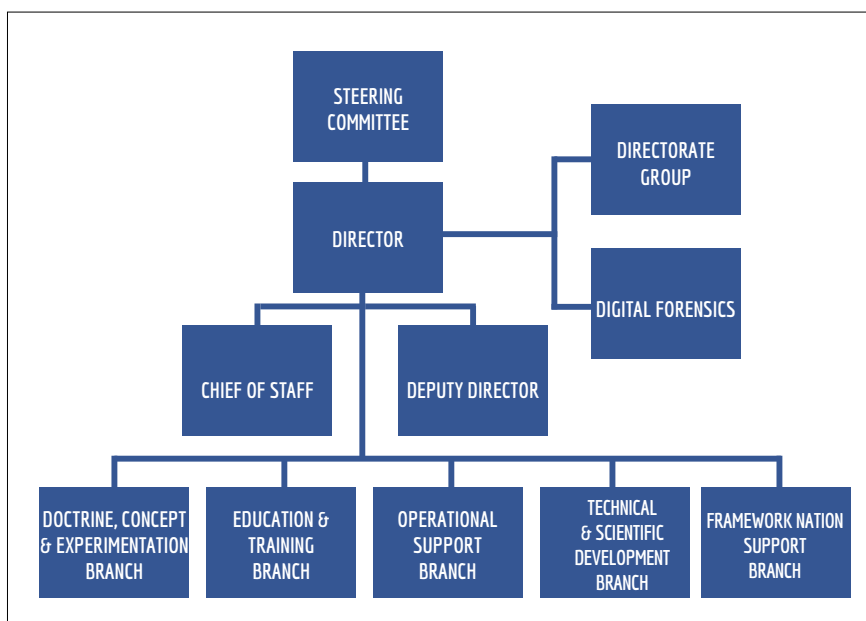
sian-speaking users of social networks like VK, OK, and Facebook in Estonia, Latvia, and Lithuania.

Analysis revealed the presence of a relatively small but significant proportion of active ideological users in every network in each of the Baltic States. The study showed that 10% of Russian-speaking social network users (identified as real people rather than bots) generate 70% of the ideological information found on those networks. Many events taking place offline are used as pretexts to push certain topics into public discussion, making use of dramatic language. Particular attention is paid to topics related to the Second World War, the USSR, present-day Russia, and anti-Western sentiment. Russian-speaking sectors of social networks in the Baltic States are thus widely used both to continue Russia's information activities against EU and NATO member countries while cementing its own positive image among the Russian-speaking population of Estonia, Latvia, and Lithuania.

Researchers identified clusters of clearly active and interconnected ideological users, each of which specialises in the creation (Writers), distribution (Distributors), or consumption (Readers) of ideological information. There is a significant – and growing – number of Russian-speaking social media communities based in the Baltic States which exhibit pro-Kremlin, pro-Russian and anti-Western orientations. They serve as sources of ideological posts that are widely disseminated by active users who capitalise on their connectivity and visibility among the Russian-speaking users of VK, OK and FB in the Baltics.

The “Robotrolling” Quarterly Report

The latest quarterly of the Robotrolling report has concluded that anonymous human-controlled English-language accounts, expressing positions in support of or in opposition to the US President, have dominated online conversations on Twitter. Robotrolling considers mentions on Twitter of NATO together with one or more of the host countries Estonia, Latvia, Lithuania, and Poland. In the period from 1 May to 31 July 2018, Russian-language bots created 49% of all Russian-language messages about NATO in the Baltic States and Poland. In comparison, bots created 19% of all English-language messages for the quarter. The increasing proportion of anonymous accounts active during key political moments indicates that anonymity is being abused to cloak manipula-



The structure of NATO's StratCom COE

tion on social networks. The Centre thus calls on social media companies to keep investing in countering platform misuse. Additionally, the Robotrolling report presents the first quantitative analysis comparing English- and Russian-language posts from accounts attributed to the St Petersburg ‘troll factory’. Amongst the accounts identified by Twitter as originating from the notorious St Petersburg ‘troll factory’ – the Internet Research Agency (IRA) – 26 also posted about NATO in the Baltics and Poland. Our algorithm correctly identified 24 of these as bot accounts. The other two accounts were anonymous human-controlled (troll) accounts.

The IRA bombarded citizens in Russia and neighbouring states with pro-Kremlin propaganda. English-language content created by the IRA sought to exacerbate societal divisions by posting to fake accounts supposedly operated by Trump supporters, and by arguing both sides of the Black Lives Matter controversy. Russian-language material closely echoed and amplified the narratives popularised by Russian state media. The fake accounts posted messages in support of Putin, his government, and its positions on Syria and Ukraine, and also published material exaggerating threats to Western democracies.

“The News Hero” Game

Use of technology and social media is a focus point of the NATO StratCom COE. After a hackathon that took place in 2017, the Centre gave an opportunity to execute one of the ideas – a Facebook

game designed to help readers develop ‘fake news’ spotting abilities. The game is hosted on Facebook and is open for all Facebook users. Players are put in charge of their own publishing company; they earn virtual currency and gain an audience for publishing accurate news. The game is divided into three levels, each encouraging the players to think about the possible ways they could be fooled. The Fact Checker screen prompts the players to question the sources and provides tips on how to distinguish between an accurate and a misleading story. With this game, the NATO StratCom COE hopes to burst the bubble of an elite-dominated discussion about critical thinking and empower the society to become more conscious users of media through a gamified approach. The game intends to enhance readers’ resilience against the disinformation.

The Riga StratCom Dialogue

Each year, NATO StratCom COE organises the two-day conference ‘The Riga StratCom Dialogue’. In 2018, the conference looked at what makes an impact on people, how we process information, how technology affects us, and how it affects social processes, and in particular, elections. The Riga StratCom Dialogue gathered 700 people from 42 countries which provides for a multitude of very different perspectives, a rich background for the debate, and an even richer background for the potential solutions. All conference sessions are published on the Centre’s YouTube channel. The next Riga StratCom Dialogue will take place on 11-12 June 2019. ■

Što Sada, Croatian Air Force?

Georg Mader

It's just embarrassing in many ways – for the Croatian political elite, for the Israeli programme officials involved and for the Croatian pilots who now have to risk their lives again in the worn-out MiG-21.

The question in the title – "What now?" – is followed by the sobering answer "Back to the beginning".

In February, the Croatian Prime Minister Andrej Plenković had to justify himself before the Zagreb Parliament because of the failed purchase of the Israeli fighter air-

craft for a debate on the failed jet purchase as unfounded and false and proposes that Parliament reject the conclusions of the motion. Such a motion for the unsuccessful

while it was the prime minister and the president who failed: "You didn't lobby President Trump!" Citing military analysts, he further claimed that "NATO's strategy did not foresee Croatia having its own combat aircraft."

Prime Minister Plenković rejected opposition allegations that the failed jet purchase jeopardised Croatia's security and position in the international community, adding that the allegations were based on superficial assessments, a lack of understanding of the issue, and political opportunism.

No Aircraft for Croatia

Defence Minister Damir Krstičević recalled that "in connection with the US approval for transfer by third parties (TPT) I would like to stress that the country that sells the military equipment, in this case Israel, is responsible for obtaining approval for TPT. Croatia was aware from the outset of the need to obtain approval for TPT, but it is impossible to completely eliminate all risks in the process. The public has been informed about every step of the procurement process, including the difficulties in obtaining approval for TPT".

Diplomats and military personnel from all sides involved, including the US ambassador to Croatia, Robert Kohorst, repeatedly stressed that Croatia's international reputation had not suffered. Kohorst contradicted media claims that the US never advised Croatia not to buy the Israeli F-16s, and both the US and Israel stressed that they wanted to further expand NATO and partner relations with Croatia and deepen their defence cooperation with the Western Balkans nation. The Israeli Ministry of Defence publicly stated that Croatia demonstrated professionalism and sound judgment at every stage of the process, but was not responsible for the outcome of the process, as confirmed by the US.

However, Croatian officials have informed the local media that the US Government accused Israel of unfair competition; the Americans had also offered their own used F-16s to Croatia in the tender. Other bid-



Photo: MoD Croatia

Croatian Air Force MiG-21bis jets

craft F-16 BARAK. He stressed that he fully supported the strongly criticised Defence Minister Damir Krstičević as all activities related to the purchase had been carried out transparently and lawfully, and he reminded Parliament that one of the reasons why the purchase of the fighter aircraft had been started in the first place was a botched Ukrainian overhaul of the outdated MiG-21 in 2013, when the government was led by the Social Democrats.

Wild Allegations

Plenković said during a debate on the motion supported by the SDP: "The government rejects all allegations in the motion

ful overhaul of MiG jets had not been filed, although the case was then the subject of legal proceedings in both Croatia and Ukraine."

Although the opposition tried to make political gains, it had to make some concessions when it came to the fluctuating number of jets: "Your government has reduced one of the most important strategic decisions to a cheap PR exercise and crisis communication. With your lack of transparency, you have given new arguments to the numerous opponents of the plan to buy fighter planes, thus endangering the future of the Croatian Air Force (HRZ) and national security. How can you trust your plans if you want more used aircraft one day and fewer new jets the next? You are no better than those who think that the skies over Croatia should be handed over to Italians and Hungarians," said Nikola Grmoja of the opposition MOST party.

Another opposition member, HRAST MP Hrvoje Zekanović, added that Defence Minister Krstičević had done a good job,

Author

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Photo: MoD Croatia

In August 2018, Israeli F-16s flew to Croatia to promote their sale.

ders were Greece, which also offered used F-16s, and Sweden's FMV, which offered JAS 39 GRIPEN fighters. After the failure of the Israeli BARAKs, it is likely that the equally unfortunate US Government could offer improved F-16Vs or even newly built F-16 Block-70s at a good price, ruining Saab's last hope of selling GRIPEN in Eastern Europe or the Balkans. It is noteworthy that a decade ago the GRIPEN lost – quite unexpectedly – to various F-16s in Romania and Slovakia, and it is likely to do so again in Bulgaria. Although the GRIPEN might even have been the better solution for these nations, the political importance of their country of origin, Sweden, proved once again to be too small when compared to the "security orientation" towards the USA.

Over 1,000 E-mails

The Croatian news agency HINA reported on a "non-paper" of the American embassy in correspondence with Deputy Defence Minister Petar Mihatov, with which the embassy allegedly "warned" against procuring the used F-16s from Israel. Mihatov replied: "During the award procedure there were many official and unofficial communications, as well as many questions which we solved in consultation with our partners, because it was a very complex project. In such a complex process, in which over a thousand e-mails were exchanged, there was demanding correspondence at several levels. We had a number of additional consultations with both the American and Israeli sides. What is crucial, however, is what is stated in all official documents that Israel, as the selected bidder, had an obligation to obtain the US licence to which it officially committed itself when accepting the bid by attaching a provisional licence. The only

important thing is that the US has not prohibited the sale of Israeli aircraft to Croatia in any official document, but has issued the official provisional licence required for the initial validity of the Israeli offer".

TPT as the Breaking Point

At midnight on 5 January, the deadline set by the US State Department for Israel to officially respond to the US demand for the removal of all non-American technologies from aircraft sold to the HRZ expired. According to Israeli sources, Israel did not send an answer to the Americans. When Zagreb found that the obstacles were mounting, Croatia established its own deadline for Israel to deliver the aircraft; Croatia clearly noted that it was up to Israel to obtain US approval to deliver the aircraft. When Israeli Prime Minister Benjamin Netanyahu met US Secretary of State Mike Pompeo in Brazil at the inauguration of the new President

Javier Bolsonaro, he noted that Israel was "not ready to remove all Israeli equipment from the F-16s" and de facto confirmed that it could not supply Croatia with the F-16 in the desired configuration.

The Israeli Air Force had about 125 BARAKs in service; at the time these were the backbone of the combat strength of the service. About 48 of these aircraft are two-seater D-models. These are fully missionised and have the same combat capabilities as the single-seaters, although the D-models carry a little less fuel internally and have slightly different handling characteristics at the outer edges of its flight envelope. Israel has upgraded this fleet several times, including improvements to its mission systems, cockpit displays, HUD and structures. Further EW upgrades were probably also part of this series of modifications and other upgrades, including those required to make the aircraft fully NATO/Europe compatible for Croatia.

Israel's offer to Croatia has changed significantly over the course of 36 months. Originally, F-16A/B models were to be offered, and then a so-called mixed fleet with F-16C/D models was also considered. In the end, it seemed that Croatia chose only two-seater D-models with their characteristic equipment tunnel between cockpit and stern. These two-seater aircraft are particularly appreciated by the Israeli Air Force and have proven their worth several times in operation.

It was therefore not an option for anyone to remove the considerable amount of deeply embedded EW and target systems that Israel Aircraft Industries (IAI) and ELBIT had installed since the end of the 1908s in the F-16s and return the jets to their original condition before selling them to Croatia. The Croatian MoD had even stressed several times that these changes were deci-

Photo: Georg Mader



Croatian AF MiG-21s at Pula Air Base

sive for its choice. "This aircraft meets our needs," confirmed Davor Tretinjak, official of the MoD, in 2018.

In the end, everything collapsed when the outgoing US Secretary of Defense James Mattis refused in one of his last official acts to soften the US conditions for the trans-

found their dark way into embargo country, although it was later found out that they had been acquired in Ukraine.

Like many other FISHBED users, the Croatian AF suffered losses – not at the terrible speed of the Indian AF, but nonetheless painful given Croatia's small fleet. In Sep-



Photo: Georg Mader

One of 16 OH-58D KIOWA WARRIORS donated to Croatia by the US under the Excess Defense Articles (EDA) partner programme

fer of the aircraft. Israel then announced that it had not received US approval for the TPT. This was the moment when Croatia decided to cancel the acquisition of the 12 former Israeli AF jets for about US\$500M (HRK2.9Bn) to be repaid over a 10-year period. Nevertheless, the government had to admit that no guarantees were obtained during the planned purchase, as this type of procurement does not require guarantees. At the same time, the MoD announced that the next attempt to buy fighter aircraft would place more emphasis on the interdepartmental nature of the process.

The Croatian MiG-21 Saga

The author, who lives in Vienna, has been acquainted with the Croatian MiGs since Rudi Peresin flew a JRV MiG-21 to Klagenfurt in 1991 (to return to Croatia one week later, only to die three years later when shooting over the Save border). While his MiG-21R is still in the Air Force Museum on the Zeltweg, the author briefly did some research in Zagreb-Pleso in the 1990s, because rumours were circulating that the up to 40 MiG jets used in 1995 from the former East German NVA inventory had

found their dark way into embargo country, although it was later found out that they had been acquired in Ukraine. In 2010, two MiG-21s collided and crashed, with the two pilots successfully ejecting. In 2013, the unique and striking red and white checkerboarded MiG-21UM '165' lost its rear canopy in flight.

And when pilot Stanko Hrženjak took a burning MiG-21 – not one of the 12 soon to be overhauled in Ukraine – to a controlled crash in an unpopulated area having successfully ejected, now retired general and former Croatian "air chief" Josip Štimac stressed that the MoD and the HRZ should create conditions for military pilots so that Croatia would not lose its air defence capability. Referring to Slovenia and the Baltic States, he recalled that "Croatia must not lose this capability under any circumstances, and I hope that the relevant people in our government and armed forces understand this problem and will address it seriously."

For many years, there was no funding and no political will for a replacement, and two attempts were made to modernise the dwindling fleet. Croatia initially placed an order for the overhaul of the Romanian Aerostar, which included the modernisation of eight MiG-21bis fighter jets. The company also supplied four further devel-

oped UMD model two-seaters. This was back in 2003, with a prolonged service life of 10 years or a warranty as to the "expiration date".

Ten years later and still without any tangible political commitment on the radar, Croatia approached Ukraine, and in April 2014 the HRZ from Odessa received the first MiG-21bis fighter aircraft to be upgraded from Pleso Air Base near Zagreb. Seven Croatian jets – now MiG-21bis-D (in Croatian "D" stands for "Doraden" or "Modified") – were initially overhauled by the Ukrainian state company Ukrspecexport under a contract worth €13.9M signed in June 2013. In addition to the NATO and ICAO standards, the agreement also included the supply of five additional single-seaters, which were converted and equipped according to the specifications of the Croatian Air Force. A Ukrainian team of experts supported the Croatian engineers and technicians in reassembling the aircraft in Croatia and prepared the aircraft for final testing and acceptance by HRZ.

The last aircraft was delivered in July 2015, after the Air Force had conducted flight tests. However, the delivery of the entire fleet was delayed due to problems with the integration of new navigation and communication devices and challenges posed by analogue-to-digital signal conversion.

In fact, according to the author's sources in Croatia, problems began to crop up since the arrival of the planes. In early 2016, only three aircraft were available for operation, while five were not operational. Investigators found that some serial numbers on the airframes had been changed to Algerian and that the changed parts did not correspond to those listed in the documents, giving rise to the suspicion that the additional aircraft and/or parts could be much older than indicated by the accompanying documents supplied by the Ukrainian company. It was then examined and confirmed that the modernised FISHBEDs did indeed contain old parts from Bulgaria, Algeria and the former USSR. To make matters worse, the Yemeni Air Force (now wiped out by Saudi and UAE attacks) complained that five of the jets procured by Croatia were actually still in Yemen's possession, even though Yemen had left these aircraft sitting unpaid for in the Odessa repair plant for years.

Therefore, Croatia then returned four of the repaired MiG-21s due to malfunctions caused by sloppy work, such as fuel leaks and defective navigation equipment. To make matters worse, in February 2018

Croatian media reported that the District Court of Zagreb was considering a case of corruption in the repair of the aircraft in Ukraine. The Bureau for Combating Organised Crime of the Croatian Ministry of Justice had accused two people of receiving bribes in the purchase and repair of the 12 MiGs purchased at the Odessa Aircraft Repair Plant.

Croatian sources later reported to the author that Zagreb had claimed contractual penalties as a result of late delivery and that the daily availability of aircraft had again fallen to less than the fingers on one hand.

Regarding the upgrades in Romania and Ukraine, however, Gen. (ret.) Štimac said these were desperate short-term solutions and the HRZ would need a long-term solution for the Croatian Air Force for the next 30, 40 or 50 years. "We need a professional debate, and this recent crash should awaken Croatia – not only the public, but above all the people who care about Croatia's future – to see what we should do above our heads in the next 30, 40 years."

Due to 15 years of delays in the acquisition of a new jet squadron and the unsuccessful overhaul of the current MiG-21s in Ukraine, the HRZ now has on average only three to four fully operational aircraft, which is the very minimum. If the capability of the HRZ continues to be compromised or unsafe, Croatia has no choice but to inform NATO's command of its inability to control its skies and demand that responsibility be assumed by the air arm of one of the neighbouring Member States.

Showing Determination

The Croatian president is determined that this will not happen: "We will learn lessons from this, but we are determined to modernise the Air Force and we will launch new activities to that end. We will launch a new call for tenders for fighter aircraft to provide Croatia with the high-quality multipurpose aircraft it needs to monitor its airspace and contribute to the Alliance. Our government will do everything in its power to make this happen." And President Plenković addressed the opposition in Parliament: "Thanks to the Lord neither you nor these people of MOST will ever be able to decide anything that concerns the government, neither the Air Force nor foreign policy. These are nothing but the dreams of you people who use these issues to attract public attention without providing arguments or having technical knowledge."

Photo: Georg Mader



A Croatian Mi-171 helicopter during the KFOR mission

Rotary Modernisation

In developments parallel to the messed up fighter acquisition, the Croatian MoD is adding to the HRZ equipment with second-hand BLACK HAWK UH-60 helicopters. Defence Minister Krstičević met HRZ pilots at the Pleso Air Base last year and informed them that the Ministry was working on a tactical-technical study on the acquisition of multipurpose helicopters. The study, which has not yet been published, will show which helicopters are best suited to the needs of the armed forces. It is planned to receive a squadron of new transport helicopters by 2025, when the current Mi-8 helicopters will be phased out. The aim is to switch to Western aviation technology in the next few years, with the exception of the 10 newly built Mi-171Sh transport helicopters, purchased as a partial payment for Soviet debt; they are currently undergoing a general overhaul and will remain in service for another 10 years.

The purchase of BLACK HAWK helicopters has been debated since 2014, when former Minister of Defence Ante Kotromanović discussed the idea with former US Vice President Joe Biden. The aim was to make Croatia more independent from Russian technology. According to unofficial sources, in 2015 the US Government submitted its offer for the new BLACK HAWK UH-60 model-M and for the used and overhauled UH-60 model-A, which – similar to Austria – will be upgraded to model-L. The new UH-60 model-M will be available in the near future. The US Government also submitted an offer for 16 new Bell UH-1Y VENOM helicopters worth HKR760M. In addition, several other

manufacturers have presented their products in recent years. However, in 2016 it was determined that Bell helicopters were too expensive for Croatia.

The Croatian MoD was subsequently invited to send a request to the US for a donation of 12 UH-60 model-A helicopters, as part of the Excess Defense Articles (EDA) partner programme. Through this programme, the US military donates or sells its defence surplus to partner countries. This way, the Croatian Army has already received MRAP and M-ATV vehicles and 16 surplus OH-58D KIOWA WARRIOR light helicopters. Delivered by ship to Zadar-Zemunik from August 2016 on, in September 2017 the latter successfully conducted the first tactical live firing and rocket launching within the 93 Squadron which involved 12.7mm MGs, 70mm HYDRA unguided rockets, HELLFIRE training rounds and Heckler & Koch G36CV guns.

The A-model of the BLACK HAWK is the original version of the helicopter; it has a crew of four and a transport capacity for 11 passengers. It was produced from 1977 to 1989, while the upgraded model flew until 2002 and is equipped with larger rotor blades ensuring higher lift and carrying capacity, digital avionics, including an early glass cockpit (the obsolete and unsupported Rockwell-Collins displays of which are forcing Austria to renew the cockpits with US supplier ACE Aeronautics' ACEHAWK concept), and a more advanced computer flying system. If these plans are put into practice, it would mean that the process of replacing Russian technology with Western equipment in another "new" NATO member is almost complete. ■

Arming the Attack Helicopter

Doug Richardson

Developed and fielded as a result of early US combat experience in Vietnam, the attack helicopter has become a vital tool on the modern battlefield, hunting down and engaging enemy vehicles or even personnel.

Its armament can be a mixture of custom-designed weapons, or existing weapons that have been adapted for the airborne role. These fall into three broad categories – guns, unguided rockets, and guided missiles.

Single-Barrel Weapons

Single-barrel machine guns and cannons use part of the energy released by the exploding cartridge – obtained either by making use of the otherwise-wasted recoil

case, load a fresh round, close and lock the breech, then release the firing pin in order to explode the cartridge and repeat the entire cycle.

The Eurocopter (now Airbus Helicopters) TIGER HAP (Hélicoptère d'Appui Protection) and HCP (Hélicoptère de Combat Polyvalent) were an early application for the GIAT (now Nexter) THL30 turret system and 30 M781 cannon. The gun is a single-barrelled weapon with a single ammunition feed. On the TIGER installation, the turret contains 450 rounds of

attacking ground targets, or proximity-fused rounds when attacking enemy helicopters.

On the Mi-28 series, 2A42 is installed in the chin-mounted NPPU-280 turret, but since the Kamov types use a dual-rotor configuration that allows the nose to be positioned independently of the flight vector, the cannon is installed in a semi-rigid mount on the helicopter's side which allows only a small degree of movement in elevation and azimuth.

While early examples of the Mi-24 HIND-E helicopter had a nose-mounted 12.7mm Yakushev-Borzov YAK-B rotary machine gun, the later Mi-24VP and Mi-35 versions use the GSh-23L cannon. Best known as the weapon installed on many Soviet-era jet fighters such as the MiG-23 FLOGGER and late-model versions of MiG-21 FISHBED, this has two barrels that share a single mechanism which uses the recoil from firing one barrel to load the other.

IST Dynamics' F-2 cannon turret used to arm the Denel ROOIVALK attack helicopter uses an unusual configuration in that the ammunition bins are mounted on the outside of the aircraft rather than internally – a feature intended to make it easy to integrate the turret onto new types of helicopter such as the Algerian Air Force's upgraded Mi-24s. It uses a 20mm GI 2 single-barrelled cannon firing at up to 750 rounds per minute.

Rotating Series of Barrels

One weakness of a single-barrel weapon is that if a round of ammunition does not detonate when its primer is initiated, the gun stops firing. This potential unreliability can be avoided by using some form of power-driven breech, and relying on an external source of power for loading and unloading.

The best-known modern example of this approach is the General Electric M61A1 VULCAN cannon carried by many US fighters, each of whose rotating series of barrels is at a different part of the loading/unloading cycle, with the energy needed



Photo: UK MoD

A British Army technician adjusts the 30mm Chain Gun of an AgustaWestland APACHE AH Mk 1 helicopter.

energy or by extracting a small amount of the hot gases from the barrel – to unlock and open the breech, extract the spent

30 x 113B ammunition, and the cannon can be set to fire single shots, bursts of preset length, or continuous fire.

Originally developed to arm the BMP-1 tracked infantry fighting vehicle, the 30mm Shipunov 2A42 cannon was adopted for the Mil Mi-28 and -28N HAVOC, Kamov Ka-50 HOKUM-A and Ka-52 HOKUM-B attack helicopters. Designed by the KBP Instrument Bureau, the 2A42 is a single-barrelled gas-operated weapon that can fire armour-piercing rounds when

Author

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to turn the barrels and operate the individual breech mechanisms being provided by an electric or hydraulic motor. While one barrel is firing, the others are being progressively loaded and unloaded during the time taken for the entire barrel assembly to make one revolution around its axis. The most commonly used helicopter armament of this type is the General Dynamics Armament and Technical products M197, a three-barrelled derivative of the VULCAN cannon. Committed to production in 1969, it is used by types that include the modernised AH-1F, the AH-1J SEACOBRA, the AH-1W SUPERCOBRA, and the Agusta A129 MANGUSTA. It has a rate of fire that is selectable, with a maximum of 1,500 rounds per minute.

The Revolver Cannon

In the early 1940s, the Mauser company developed a scheme in which the rotating assembly did not include barrels. A revolving drum allowed a process of loading and unloading similar to that of the VULCAN,

but the round was fired only as it became aligned to the weapon's single barrel.

For its Light Combat Helicopter (LCH), HAL selected the Nexter THL20 turret armed with a 20mm M621 externally-powered revolver cannon. As its designation Tourelle Hélicoptère Leger (THL) indicates, the THL20 was designed to be a lightweight system suitable for use on helicopters destined for the close-support role. The cannon fires 20mm M50 ammunition, which is interchangeable with US M56 rounds.

When engineers from what was then Hughes Helicopters began an independent research and development programme in 1972 with the aim of developing an externally powered single-barrel weapon able to fire the US Army's existing M50 20mm round, they opted to base their design on a continuous belt of industrial chain of the type commonly used to create drive belts for machinery. This is positioned in a horizontal rectangular track by four sprockets, one of which is powered.

As the chain rotates, a bolt carrier located at one point along its length drags the weapon's bolt forward toward the breech, pushing a round into the chamber, forcing the bolt face into the breech, and providing the power needed to turn and lock it. As the bolt carrier begins its journey towards the rear of the weapon, it unlocks the breech and extracts the spent case. Once fully rearward, it repeats the cycle for as long as the chain is being power driven. Since this operation cycle is not dependent on variables such as weapon cleanliness, spring tension or gas pressure, the weapon is resistant to the effects of dirt and wear, and is very reliable.

Unguided Rockets

Like guns, unguided rockets can be used when a helicopter is hovering, in forward flight, or in a dive. In the latter two cases, the helicopter's forward airspeed increases the delivery accuracy. Being relatively simple, rockets are easy to store and han-

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Photo: US Air Force



The Target Acquisition Designation Sight (TADS) of a US AH-64 APACHE captured this image of a Taliban infantry unit. An exploding missile warhead (presumably a HELLFIRE) and the smaller explosions caused by 30mm cannon rounds demonstrated that these weapons were as lethal to exposed infantry as ground-based machine guns had been in the 1914-18 conflict. None of the targeted Taliban combatants survived this engagement.

dle; and being relatively cheap, can be fired in large numbers.

The standard US Mk 4 2.75 inch (70mm) rocket was not the ideal helicopter weapon. When fired from a high-speed aircraft, the rocket finds itself in a high-speed slipstream when it leaves the launcher, but when fired from a helicopter, it is in a low-speed slipstream and exposed to downwash from the rotor. To get around this problem, the motor nozzle was redesigned into a scarfed form, and the resulting Mk40 motor imparted a degree of spin to the

round. While fixed-wing aircraft continued to use the Mk4 rocket, the M40 was used by US Army helicopters.

The US Navy developed a higher-thrust Mk 66 motor which was adopted for tri-service use. It was combined with new launchers and warheads and fielded as the HYDRA 70 weapon system. The HYDRA series is widely-used on Western attack helicopters such as the Boeing AH-64 APACHE, TAI/AgustaWestland T129 ATAK, and various versions of the Bell AH-1 such as the AH-1 SUPERCOBRA, AH-1J

Photo: Doug Richardson



This view of the nose section of a TAI/AgustaWestland T129 ATAK helicopter shows the aircraft's electro-optical turret and M197 three-barrel rotary cannon.

SEACOBRA, AH-1W SUPERCOBRA, and Bell AH-1Z VIPER.

For many users, a calibre of around 70mm seems to meet most requirements, so rockets of this type are widely available. Typical examples used on helicopters are the TDA Armament SNEB 68mm rocket and the FZ 70mm rocket. When more explosive is needed on target, one solution was the 5 inch (130 mm) ZUNI rocket. Able to carry a warhead in the 50-60kg class, this can be fired from four-round LAU-10D/A launchers carried by helicopters such as the AH-1J SEACOBRA and AH-1W SUPERCOBRA. However, most users have now phased this weapon out.

Russia has its own patterns of unguided rocket, including the 57mm S-5, 80mm S-8 and 122mm S-13. The heaviest Russian unguided rocket currently in service on attack helicopters is the 240mm S-24.

Reach Out and Touch Someone

A famous late 1970s advertising slogan by a US phone company urged us to 'reach out and touch someone'. In the world of the attack helicopter, this can best be done at long range by using a guided missile.

The simplest form of guidance that can be used involves transmitting from the launcher to the weapon of steering commands generated by an operator. At first this was done via a trailing wire, but some systems such as the 9M17 PHALANGA (AT-2 SWATTER) carried by early examples of the Mi-24 used a radio command link.

Steering a manually-guided missile was not an easy task, but semi-automatic command to line-of-sight (SACLOS) guidance reduced the operator's task to that of keeping his sight aligned with the target, while an automatic system tracked the missile and generated the commands needed to keep it on the line-of-sight.

Still used to arm helicopters such as the AH-1W SUPERCOBRA, and the Agusta A129 MANGUSTA, the Raytheon (formerly Hughes) BGM-71 TOW is a classic missile of this type. Although gradually improved over the decades since it was first fielded, receiving the improved warheads and fusing needed to deal with advances in tank armour, it retained wire guidance until wireless versions were introduced in 2012. Fielded in 1976, the 9K113 SHTURM (AT-6 SPIRAL) became the primary antitank weapon of the Mi-24V and -24P versions of Mil's well-known attack helicopter. It flies a lofted trajectory so as not to interfere with the tracking sensor of the helicopter's SACLOS guidance system,

but descends onto the sightline during the final approach to the target. Further development of the 9K113 SHTURM led to the 9M120 ATAKA-V (AT-9 SPIRAL-2), which arms the Mi-28 HAVOC and the upgraded Mi-24V and -24P. It also serves on late-model HIND variants including the Mi-24PN, -24PK-2, -24VK-2, as well as the Mi-35M and -35P.

Norinco's HJ-8 (more recently redesignated as the KD-8) uses wire-based SACLOS guidance. It was originally fielded as a man-portable system, but has been offered for use on CAIC's Z-10 attack helicopter.

SAL Missiles

Missiles that use semi-active laser guidance are gradually supplanting SACLOS designs. The best-known SAL missile on service aboard attack helicopters is probably the Lockheed Martin/Boeing AGM-114 HELLFIRE. This first entered service in its AGM-114A form for use on the AH-64, but was soon followed by the -114B and -114C variants developed for shipboard use.

A tandem warhead intended to defeat reactive tank armour was introduced by the -114F, while the -114K and -114K2 HELLFIRE II versions introduced an improved seeker and a digital autopilot. Combat experience with HELLFIRE spurred development of the -114M and -114N with blast fragmentation and thermobaric warheads respectively. The -114R added an IMU to the guidance system and introduced a 'tuneable' multipurpose warhead.

SAL guidance is also used in weapons such as the Mokopa ATGM offered for use on the Denel ROOIVALK, and the HJ-10 (also known as the AKD-10) carried by the CAIC Z-10. Roketsan uses SAL guidance for its L-UMTAS missile. The KBP Instrument Design Bureau's HERMES-A is used on the Kamov-52K. A multi-stage missile with a high-powered booster, it uses a combination of radio command and SAL guidance.

SAL guidance is also being used to create high-accuracy versions of existing unguided rockets. A range of designs is currently on offer, most of which add a new nose section combining a SAL seeker and canard control surfaces to off-the-shelf warheads and rocket motors. Current offerings include the BAE System APKWS and the Raytheon and Emirates Advanced Investments TALON, both of which are based on existing HYDRA 70 components. Other candidates include a guided rocket by FZ that incorporates a SAL seeker, IMU and control actuator system, and the ATL/Elbit Guided Advanced



Photo: UK MoD

A British AH-64 fires a salvo of unguided rockets.

Tactical Rocket - Laser (GATR-L). Harbin Jiancheng's SKY ARROW 90 is a SAL-guided version of the Type 90-1 90mm unguided rocket, but Roketsan's CIRIT is a custom-designed weapon. MBDA has developed a SAL-guided version of the 5 inch ZUNI rocket.

In 2015 TDA Armaments was awarded a contract to provide its 70mm ACULEUS-LG SAL-guided rocket to France's Light Army Aviation. After launch, the rocket flies for a few seconds while its nose-mounted seeker searches for a laser-designated target. If laser energy with the correct code is detected, the rocket deploys its canard control surfaces, then begins to correct its course.

Addition of the UGROZA guidance system to Russian S-5, S-8, and S-13 rockets converts these proven Russian weapons to the S-5KOR, S-8KOR, and S-13KOR respectively. The UGROZA upgrade fits the rocket with a SAL-based guidance system, but the method of steering the

rocket relies on sideways-firing mini-thrusters rather than aerodynamic control surfaces.

Some missiles use laser beam-riding guidance. The 9K121 VIKHR (AT-16 SCALLION) has four rearward facing detectors that respond to the laser beam transmitted by the launch aircraft, and are likely to prove invulnerable to any tank-mounted EO jamming system. VIKHR has a 10 km range and is armed with a tandem HEAT warhead. Similar in appearance to the laser beam-riding Israeli MAPATS and South African ZT3 INGWE anti-tank missiles, the Norinco HJ-9 (RED ARROW-9) has a maximum range of 5.5 km. The basic version uses laser beam-riding guidance.

KBM's 9M123 KHRIZANTEMA (AT-15 SPRINGER) was developed for use from helicopters or from ground vehicles. It is known to exist in four variants that use different permutations of guidance (radar or laser-based beam riding) and tandem HEAT or thermobaric warheads.



Photo: US Airforce

This Russian-made Mi-24 helicopter was used to provide simulated hostile threats during a US Joint Service Combat Search and Rescue (CSAR) exercise in February 2000. The aircraft has fuselage-mounted gun armament, and carries missiles and unguided rockets under its stub wings.

Photo: Doug Richardson



Rafael's SPIKE-NLOS is probably the longest-range air-to-surface missile currently available for use on attack helicopters.

Photo: BMVg



Ground crew loading a containerised PARS 3 LR missile into a launcher mounted under the stub wing of a Eurocopter TIGER

Fire-and-Forget Missiles

In many ways, the 'ultimate' weapon for an attack helicopter is the fire-and-forget missile in which an EO or IIR seeker can be locked onto the image of a distant target, and the missile fired and allowed to home onto its victim with no further action being needed by the operator.

PARSYS PARS 3 LR (originally LR-TRIGAT) was Europe's first IIR fire-and-forget missile. Development of this 6 km range weapon started in 1988 but was not completed until 2001, by which time France

and the UK had lost interest in the system. As a result, it was adopted only by Germany for its Tiger UHT helicopter. Originally known as the NT-Dandy or NT-D, Rafael's Spike-ER (Extended Range) has a maximum range of 8 km. It is compatible with the TIGER, AW129 MANGUSTA, TAI/AgustaWestland T129 ATAK, and the SUPER COBRA. The addition of a new RF datalink extends the range of the SPIKE ER2 variant to 16 km. Its seeker combines high-resolution IR and day sensors, and the operator can switch from one to the other while the missile is in flight, a feature that could help

with the detection of camouflaged targets. A tandem HEAT warhead is intended to cope with the armour of all known MBTs and provide an anti-structure capability, but an alternative Penetration, Blast, and Fragmentation (PBF) warhead is available for use against strongly-fortified positions.

Spike NLOS gives attack helicopters an even more impressive reach; in September 2018 Israel conducted a trial in the Negev Desert during which an Israeli AH-64 APACHE used a SPIKE NLOS missile to strike a target more than 50 km away. Roketsan's MIZRAK-U (previously known as UMTAS) uses a two-way RF datalink provides communications with the launch platform, and an IIR seeker offering lock-on before launch and lock-on after launch attack modes.

India's Bharat Dynamics' HELINA is a helicopter-mounted version of the NAG fire-and-forget missile. This is equipped with a 8-12 micron cadmium mercury telluride seeker and a tandem HEAT warhead, but has suffered from a protracted development programme. Development started in 1988, and test firings started in 1990. Although the Indian MoD claimed in 2006 that development had been completed, this statement proved premature. Final user trials of NAG are due to begin in the summer of 2019, allowing the system to enter production at the end of the year. The HELINA version will equip HAL's Light Combat Helicopter (LCH).

With the arrival of the AH-64D and its mast-mounted AN/APG-78 millimetric-wave radar also came the AGM-114L LONGBOW HELLFIRE, which was essentially a HELLFIRE II with a nose-mounted Ka-band active radar seeker. There have been no recent reports of progress with a planned millimetric-wave version of HELINA, but China's HJ-9A follow-on to the laser beam-riding HJ-9 is known to use semi-active millimetre wave radar guidance.

Some attack helicopters are equipped with air-to-air missiles, either for self-protection or as a weapon for use when attacking enemy helicopters. In most cases, an existing air-to-air missile such as the AIM-9 SIDEWINDER or VYMPER R-73 (AA-11 ARCHER) is carried, but a more common solution is a man-portable surface-to-air missile such as STINGER, MISTRAL, FN-6 and QW series. China's TY-90 air-to-air missile was custom-designed for helicopter use. This IR-homing weapon weighs only 20 kg, and has a range of 6 km. It initially entered service on Z-9W and -9A licence-built versions of the Eurocopter DAUPHIN, but now arms the Z-10 attack helicopter. ■

Active and Reactive Vehicle Protection Systems

Sidney E. Dean

As anti-armour weapons have become more powerful, armies have reacted by increasing the thickness and resilience of vehicle armour. Modern ammunition, however, destroys even the strongest armour, forcing armies to develop reactive and active protection systems.

The advent of potent shaped-charge warheads and kinetic-energy penetrators (KEPs) capable of defeating very thick armour forced armed forces to rethink their approach to vehicle protection, especially since thicker – and heavier – armour impedes mobility, increases fuel consumption and imposes significant strain on the power train and suspension.

Reactive Protection Systems

Reactive armour (RA) is designed to neutralise the impact of shaped-charge warheads and kinetic penetrators. It can be integrated into the vehicle's primary armour or employed as modular or applique armour attached over the vehicle's organic armour. Reactive armour was first patented in West Germany in 1970, but Israel was the first nation to introduce it operationally, deploying RA-equipped M-60 tanks during the Lebanon War of 1982. There are various categories of reactive armour, including Explosive RA (ERA), Non-Explosive RA (NERA), and Electric/Electromagnetic RA.

ERA is composed of high-explosive sandwiched between two armour plates. When a shaped charge strikes the ERA, the warhead's energy causes the sandwiched explosive to detonate, neutralising the warhead's energy before it reaches the vehicle's organic armour. Similarly, the ERA's explosive force deflects KEPs such as sabot rounds, preventing their penetration of the main armour; heavy ERA can even break the kinetic rods.

Modern anti-tank missiles (ATM) often employ a tandem shaped charge warhead;



Photo: Rheinmetall

Rheinmetall's ADS active protection system mounted on a German Army FUCHS armoured personnel carrier. The US Army is currently evaluating the ADS for the STRYKER infantry fighting vehicle.



Photo: Rheinmetall

Rheinmetall's ADS active protection system mounted on a LEOPARD 2 MBT

this consists of a smaller explosive charge at the warhead's tip, which has the sole purpose of tripping the ERA and exposing the underlying organic armour, and a larger main charge intended to attack the now exposed organic armour. In addition to this vulnerability, explosive armour has the disadvantage that it creates shrapnel, forcing dismounted infantry to remain at a

safe distance from the vehicle rather than sheltering in its vicinity.

In place of the high-explosive, NERA employs an inert material such as rubber as liner between the armour plates. The basic principle behind its function – dissipating the warhead's energy prematurely – is the same as that of ERAs, but non-explosive reactive armour is generally less effective

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The IRON CURTAIN APS developed by US firm Artis LLC destroys incoming projectiles only centimetres before impact on the protected vehicle. It was under consideration for the STRYKER IFV, but in 2018 the US Army found that, while generally effective, the IRON CURTAIN did not perform sufficiently well under adverse weather conditions.

than explosive plates. On the other hand, NERA is lighter and cannot be defeated by tandem warheads.

Electric or Electromagnetic RA is a comparatively recent concept. It consists of two metal plates separated by a nonconductive buffer. The plates are under a high-voltage charge, forming a capacitor. When a warhead or KEP strikes the outer plate, it penetrates the nonconductive buffer, bringing the two charged plates into contact. The capacitor releases its accumulated energy, repelling or weakening the projectile's blast or kinetic energy.

United States

Reactive armour is deployed worldwide, especially on heavier armoured vehicles capable of carrying extra weight. Because of the various negative factors – including the burden imposed by the additional weight – it is normally mounted only in high-threat scenarios, such as operations against forces deploying sophisticated anti-tank weapons or IEDs.

The US Army provides a prime example. The organic armour on the ABRAMS M1 MBT is considered among the best in the world, eliminating the need for add-on protection in many cases. However, reactive armour was mounted on ABRAMS tanks as extra protection against IEDs during stabilisation operations in Iraq. In 2017, ERA kits were also sent to armoured units in Germany in reaction to rising tensions with Russia.

The US Army maintains two different ERA systems for the M1; both are designated as ARAT (ABRAMS Reactive Armour Tile) and supplied by GDLS. The brick-like M19 ARAT 1 was introduced in 2006 and is mounted

horizontally to defend against vehicle-mounted and man-portable weapons such as RPGs. The M32 ARAT 2 was introduced in 2008 and resembles ceramic roof tiles. The curved shape is better suited to deflecting high-energy ordnance. Unlike the M19, the M32 can be mounted at a downward or upward angle to optimise defence against IEDs or against altitude-launched weapons. The M19 can be mounted alone. Alternately, the M32 can be placed directly over the M19, creating a two-layer ERA system. Importantly, ARAT is designed to only react to high-energy explosive or kinetic weapons; small arms fire will not set off the tiles, so enemies cannot strip a tank of its RA through machine gun fire.

GDLS, in conjunction with Rafael, also supplies separate ERA systems for the M2 BRADLEY Fighting Vehicle System (BFVS Armour Tiles) and for the STRYKER family



An IDF NAMER IFV. The hexagonal radar (one of four) and trapezoidal countermeasure launcher (one of two) are mounted atop and to the rear of the vehicle.



SAAB's Land Electronic Defence System 50 soft-kill electronic countermeasure system is deployed on the Swedish army's CV90 combat vehicles.



Photo: Vitaly Kuzmin

The sensors and countermeasure launchers of the AFGHANIT hard kill APS are positioned atop the turret of the T-14 MBT.

(STRYKER Reactive Armour Tiles – SRAT II). Introduced in 2014, these rectangular tiles use an insensitive high-energy explosive to counter shaped charge threats, and are lighter than previous ERA applique systems. The BFVS Armoured Tiles are rated against all shoulder-fired and most tube-launched AT-weapons, while SRAT II is optimised for urban settings.

Europe

Several European firms are refining their reactive protection systems, hoping to improve performance while minimising negative aspects.

Dynamit Nobel Defence GmbH has developed CLARA (Composite Lightweight Adaptable Reactive Armour), also known under the German designation HL-Schutz

Rad/Kette ("shaped charge defence for wheeled and tracked vehicles"). By utilising composite fibre materials rather than metal or ceramic plates, CLARA reduces the threat posed by shrapnel from detonating ERA blocks. Several variants are produced, with aerial density – defined as the weight of the armoured panel (in grammes per square metre) divided by the protection area of the panel – varying between 70 and 270 kg per square metre. The lowest-density segments provide protection against RPGs, while the strongest variant can stop 30mm sabot rounds. CLARA has deployed on German Army PUMA IFVs and been tested on the MARDER IFV as well as the BOXER APC variant. In late 2017, the United Arab Emirates News Agency released images of UAE LECLERC MBTs equipped with the CLARA system.



Photo: Vitaly Kuzmin

Russia's ARMATA T-14 MBT is equipped with MALACHIT explosive reactive armour and the AFGHANIT APS. Details of the MALACHIT ERA remain classified.

Swiss company RUAG has also developed a composite-based ERA. The SidePRO-CE applique armour is applied to the flanks of armoured vehicles to defend against high-energy anti-tank systems (including those with tandem warheads) as well as against KEPs. According to RUAG, the ERA's explosive reaction is confined to a minimal area, reducing the potential for collateral-inducing shrapnel. Customers include Jordan (M60 PHOENIX MBT).

Poland has improved its original ERAWA (Explosive Reactive Armour – Wiśniewski, Adam, named to honour its developer) by introducing the ERAWA 2. The ERAWA 2 contains two explosive charges and is specifically designed to neutralise tandem warheads. There is also a limited capability against KEPs. ERAWA and ERAWA 2 plates are smaller than most ERAs, with each block measuring 15x15 centimetres. This allows for a very tight fit, with minimal gaps between blocks. ERAWA is suitable for medium to lightweight armoured vehicles.

Russia

Russia's third-generation RELIKT ERA introduced in 2006 is deployed on the T-72B, T-80B and T-90AM MBTs as well as the BMPT RAMKA/TERMINATOR fire support vehicle. It consists of a 2 kg explosive tile sandwiched between two metal plates; an inert buffer between the ERA and the organic armour provides additional protection for the tank body. Rectangular ERA boxes protect the flanks and back of the tank, while trapezoidal ERA kits are arrayed around the turret. The manufacturer NII Stali describes RELIKT as twice as effective against shaped charges as the Soviet-era, second-generation Kontakt-5 ERA. It also reduces sabot penetration by 50%.

With the advent of the ARMATA armoured vehicle series, Russia has introduced a fourth-generation ERA designated as MALACHIT. The precise composition of the ERA is not publicly known; Western experts speculate that the plates might be composed of a laminated ceramic composite matrix. The Russian news agency Tass has reported that the ARMATA T-14 MBT will be fully protected not only against Anti-Tank Guided Missiles (ATGM) but also against tank shells up to a calibre of 150mm.

Active Protection Systems – Hard Kill

Of course this claimed level of protection is not based solely on the performance of the MALACHIT reactive armour. The ARMATA family is also equipped with the AFGHANIT



US Army soldiers apply the ABRAMS Reactive Armour Tile 1 M19 to an ABRAMS MBT in Germany.

Active Protection System (APS). The AFGH-ANIT APS includes both electronic or “soft kill” subsystems and kinetic or “hard kill” countermeasures. The former includes an electronic warfare suite to disrupt warhead guidance systems including laser guidance systems. The latter includes interceptor rounds with explosively formed penetrators to physically destroy incoming missiles, grenades and shells. Russian claims that the interceptor rounds can even defeat incoming KEPs are put in question by many western experts.

Many nations are currently pursuing APS technology, which is defined as the capability to intercept enemy projectiles shortly before impact. An APS is mounted on each individual vehicle and protects only that vehicle. The concept offers numerous benefits: an APS weighs less than additional organic armour or applique armour, and can eliminate the need for bulky slat armour; by stopping incoming ordnance before impact, it minimises concussion of the vehicle and crew, and eliminates the risk of gaps being created in the applique armour through repeated enemy targeting of the same spot. Of course, there are also negative aspects to an APS. Since hard kill systems fire projectiles, there is the risk of collateral damage/victims through shrapnel or if the APS-fired projectile misses its target; since APS countermeasures are only activated immediately before impact, secondary protective measures (such as RA) may still be required in case of APS failure to intercept; APS requires an autonomous on-board battle management system to interface on-board sensors and the actual countermeasure weapons, differentiate threats from non-threats, calculate fire-solutions, choose the optimal weapon from the countermeasure suite, and engage at the optimal time – decisions to be made within fractions of a

second. Finally, the APS must not interfere with other on-board systems, either through excessive demand for electricity or through its electromagnetic signals.

Israel

Israel has been a pioneer in APS development. Two systems stand out. The TROPHY APS developed by Rafael was declared operational by the Israeli Army in 2009 and first tested in combat in 2011. The original TROPHY, now designated TROPHY-HV (Heavy Vehicle) is designed for medium to heavy combat vehicles; it is currently in use on the MERKAVA MBT and the NAMER Armoured Fighting Vehicle, and it has been successfully integrated on the GDLS LAV III. In June 2018, the US Army awarded Rafael the initial contract to supply the TROPHY

APS for the M1 ABRAMS MBT. The German Army has selected TROPHY to protect one LEOPARD 2 tank company to be deployed with the NATO Very High Readiness Joint Task Force as of 2023.

The TROPHY-LV was introduced in 2014 for light and medium vehicles, ranging from 4x4 jeeps to armoured personnel carriers and IFVs. Both variants utilise a 360° Elta EL/M-2133 fire-control radar system for detection and targeting. Two rotating containers atop the vehicle fire 35 metal balls against each incoming missile, rocket or RPG, targeting the warhead. The balls are miniaturised explosively formed projectiles (EFP) which can either disable the incoming weapon – the preferred solution – or cause it to explode prematurely. Both variants offer a hostile fire detection capability to identify the source of incoming fire. Each container has three countermeasure warheads, so that a TROPHY-equipped vehicle can only defeat six incoming projectiles before re-loading.

The HV variant is effective against ATGMs, RPGs, recoilless rifles and tank-fired HEAT rounds, but not KEPs. It can react to simultaneous threats from different directions, including projectiles approaching from a high angle. The LV is designed primarily for urban operations and is optimised against RPGs, including those with dual/tandem warheads. The system is easily mounted atop wheeled and tracked vehicles using an integrated roof-rack assembly. In addition to the radar, the LV incorporates electro-optical sensors which trigger the counter-



The ABRAMS Reactive Armour Tile 2 (M32) resembles a terracotta roof tile. It is applied over the box-shaped M19 ARAT 1 tiles to create a double layer of defence.

measures when the enemy projectile enters the system's field of vision.

The IRON FIST APS produced by IMI also comes in different variants optimised for heavy and for medium to light vehicle classes, respectively. It utilises both infra-red and radio-frequency sensors for surveillance and targeting. Each Iron Fist has two launchers, with each launcher mounting two tubes. The tubes fire high-energy blast grenades armed with proximity fuses which detonate within 80 centimetres of the incoming projectile; target destruction or deflection is achieved solely through the grenade's blast wave, without any fragmentation effect. The system is effective against ATGMs, RPGs, recoilless rifles and KEPs. The heavy configuration includes a soft-kill electro-optical and laser jammer as a primary option before deploying the hard-kill projectile. This enables the heavy-vehicle IRON FIST to theoretically engage an unlimited number of incoming threats, in contrast to the purely hard-kill, light-vehicle variant or the TROPHY ASP. The IRON FIST has garnered several export contracts. The Royal Netherlands Army has contracted BAE Systems to integrate the IRON FIST Light Compact (IF-LC) system on its CV9035NL.



Photo: mjabbb

A Polish-built Malaysian Army PT-91M PENDEKAR MBT with Polish ERAWA 2 reactive armour.

IRON FIST Light has entered phase 2 evaluation for the US Army's BRADLEY IFV, while the Australian Defence Force has asked Rheinmetall to evaluate IRON FIST for use on the BOXER Combat Reconnaissance Vehicle. Other weapon systems being hypothetically paired with the IRON FIST include the GDLS AJAX armoured fighting vehicle and the BAE CV90.

In 2014, IMI and Rafael agreed to collaborate on development of a next-generation APS integrating the best features of the TROPHY and IRON FIST concepts. Rafael is to act as prime contractor, with IMI and Israel Aerospace Industries as partners.

Europe

Several European firms are also pursuing or upgrading APS solutions. Rheinmetall Defence offers the Advanced Modular Armour Protection – Active Defence System (AMAP-ADS). This flexible system can be customised to meet client needs. It provides a dual layer of sensors. According to the manufacturer, the first ring of sensors consists of a multi-frequency radar with planar antenna. This early warning system detects and classifies threats, and enables initial trajectory calculation. It demands only a low level of radiated power, thereby avoiding in-



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interference with other radars. The second or inner sensor ring consists of a high-resolution electro-optical system which confirms the radar findings and calculates a more precise estimate of the incoming projectile's point and time of impact, enabling a fire solution. According to Rheinmetall, initial radar detection takes place 50-200 milliseconds (10-35 metres) before impact, while the optical system acquires incoming ordnance 10 milliseconds or two metres before impact. Hard kill countermeasures deploy only four milliseconds before the hostile warhead's impact, destroying it at a distance of one metre from the protected vehicle.

This is significantly closer than most APS systems, which tend (on average) to engage at a range of circa ten metres. The difference is that Rheinmetall's ADS relies fully on directed energy to destroy or divert the incoming warhead; it does not fire any projectile or shrapnel of its own. This eliminates the threat of collateral (except, of course, from the remnants of the incoming weapon). Sensors and countermeasure pods are distributed all around the protected vehicle. Depending on configuration, the entire system adds between 140 and 500 kg of weight, making it suitable for light wheeled vehicles as well as medium to heavy IFVs and MBTs. Since larger projectiles may only be fragmented but not completely stopped by the ADS, some form of organic or applique armour is recommended to ensure full vehicle protection.

At the IDEX 2019 Exposition in Abu Dhabi, Rheinmetall introduced its new Hybrid Protection Module. It combines the ADS with two layers of passive armour components as an integrated module. The ADS sensors are sandwiched between the outer and inner passive armour layers, which protects them against shell fragments and small arms fire. The ADS countermeasure component is embedded within the external armour plate. The individual modules measure 18x15 centimetres and are intended to replace other passive modular armour on the flanks of tracked and wheeled vehicles.

China

China's NORINCO demonstrated its more traditional GL5 APS hard kill system to foreign observers in 2017 and presented it to the general public at the China Air Show in November 2018. As presented, the GL5 consists of four multipurpose millimetre-wave radars distributed for 360° coverage, four countermeasure launcher sets, and a control computer. Each of the four launch-

ers mounts three pods containing high-explosive fragmentation grenades capable of intercepting ATGMs, RPGs and tank-fired HEAT rounds. Intercept range is circa ten

as few as four – before reloading. Vehicles mounting both soft and hard kill systems engage first with the former, holding the hard kill weapons as a reserve.

Photo: Cell105



An Indian Army T-90 tank with Russian-made RELIKT-5 reactive armour.

metres from the protected vehicle. According to NORINCO, a second grenade can be fired if the first fails to destroy or deflect the incoming projectile. The GL5 is suitable for the full range of vehicles, from light tactical vehicles to MBTs.

Electronic Protection Systems – Soft Kill

While most APS concepts are built around hard kill options to destroy or physically deflect incoming ordnance, some include soft kill options as part of the package. The term "soft kill" is actually misleading, as these systems are not intended to bring down the incoming projectile, but simply to misdirect it so that it flies past the intended target. The Land Electronic Defence System (LEDS) marketed by Saab, for instance, begins with a laser-detection and soft kill suite, adding a hard kill option as an upgrade. Soft kill elements of LEDS include smoke grenades to counter laser guidance systems and dispensing flame retardant foam to alter the vehicle's infrared and radar signature. MONGOOSE rockets can be added as a hard kill option.

Other soft kill systems are based on electronic warfare or laser technology, and they can include so-called dazzlers to blind optical targeting systems. Such systems have the advantage of a virtually unlimited magazine, while a hard kill APS can engage only a limited number of targets – in some cases

The US Army is planning to include both hard and soft kill capabilities in its Modular APS architecture (MAPS). Still being defined, MAPS will provide a framework for future APS solutions across the vehicle fleet. It is intended to integrate various technologies and systems offered by different manufacturers. In late 2018, the US Army conducted a so-called "Soft Kill Rodeo" to evaluate three contenders for the soft kill component. All three contenders – BAE Systems' RAVEN Multi-Function Counter-Measure (MFCM), Northrop Grumman's Multifunction Electro-Optical System (MEOS), and Ariel Photonics' Colour Light Operational Unit for Deflection (CLOUD) – utilise electronic countermeasures to defeat incoming ATGMs. The MAPS base kit was used to control all three systems during the test.

While all three systems reportedly performed well, the US Army selected the BAE Systems RAVEN MFCM – a derivative of an airborne electronic warfare jamming system – for further evaluation. It will be mounted – together with the MAPS base kit control unit and the hard kill IRON FIST APS – on a BRADLEY IFV for a more challenging layered demonstrator scheduled for July through September of this year. This trial will further evaluate the individual APSs, but more importantly, it will evaluate the capability of the MAPS controller to integrate and coordinate the hard and soft kill systems effectively. ■

British Army WARRIOR Upgrade Trials Under Way

Christopher F. Foss

Currently, trials are underway to confirm the reliability of an upgrade designed to extend the service life of the British WARRIOR infantry fighting vehicle. Due to the cost explosion, however, fewer vehicles than originally planned are to be modernised.

Lockheed Martin UK have confirmed that reliability growth trials of the WARRIOR Capability Sustainment Programme (WCSP) have started at the British Army's Armoured Trials and Development Unit (ATDU) at Bovington Camp, Southern England and are expected to be completed in July 2020, if all goes to plan.

According to the UK MoD, entry to the Demonstration and Manufacture Phases of WCSP was approved in July 2011 at a cost of £1.3Bn with an In Service Date (ISD) of 2020, but this will now not occur. The programme is now at least three years behind schedule and has a cost growth of about £227M. The aim of the WCSP is to extend the out of service date (OSD) to beyond 2040 and includes the WARRIOR Fightability & Lethality Improvement Programme (WFLIP), WARRIOR Enhanced Electronic Architecture (WEEA) and WARRIOR Modular Protection System (WMPS).

The current WARRIOR IFV is armed with an unstabilised and slow-firing RARDEN 30mm cannon and a 7.62mm co-axial machine gun (MG) in a two-person turret originally designed by Vickers Defence Systems; the vehicle has to halt in order to engage the target. This turret has been replaced by a brand new LM UK turret armed

with the CTAI 40mm Cased Telescoped Weapon System (CTAS) and a 7.62mm co-axial MG coupled to a computerised fire-control system which includes new day/thermal sights. This will enable sta-

the FV520 WARRIOR IFV section vehicle, FV521 WARRIOR IFV command, FV522 WARRIOR repair, FV523 WARRIOR recovery/repair and FV524 WARRIOR artillery observation post vehicle.

Photo: Christopher Foss



A WARRIOR AIFV upgraded to the WCSP standard

Author

Christopher F. Foss has been writing on armoured fighting vehicles and artillery systems since 1970 and until recently was editor of Jane's "Armoured Fighting Vehicles" and the artillery element of "Jane's Artillery and Air Defence". He has lectured on these subjects in many countries and well as chairing conferences all over the world. He has driven over 50 tracked and wheeled AFV.

tionary and moving targets to be engaged under almost all weather conditions with high first round hit probability while the WCSP is stationary or moving.

The 40mm CTAS is supplied as government furnished equipment (GFE) and is also installed in the General Dynamics UK AJAX reconnaissance vehicle soon to enter service and in the French Army's new JAGUAR (6x6) reconnaissance vehicle.

LM UK have supplied 11 WCSP demonstration vehicles for the reliability growth trials at ATDU, and these include

It was expected that up to 380 WARRIORS would be upgraded to the WCSP standard, which would be supplied to the two WARRIOR battalions in each of the three armoured infantry brigades plus additional vehicles for war reserve and training. As the British Army will now form at least two strike brigades and reduce to two armoured infantry brigades, the number of WCSP vehicles is expected to be reduced to perhaps 250 to 280 units with a potential commit to production in early 2020. ■

Water Purification

Dan Kaszeta

The logistical need for water in modern conflicts is enormous.

Various military operations in dry climate zones such as Iraq and Afghanistan require extensive water supplies.

Napoleon famously, if apocryphally, wrote that an army travels on its stomach. However, an army might even fight for a day or three without any food. But an army needs water every single day or the soldiers start to fall over.

engine cooling, washing vehicles, decontamination, or field laundry is not likely to require the same level of purification as potable water. However, potable water for drinking, personal hygiene, heat casualty treatment, field catering, and medical

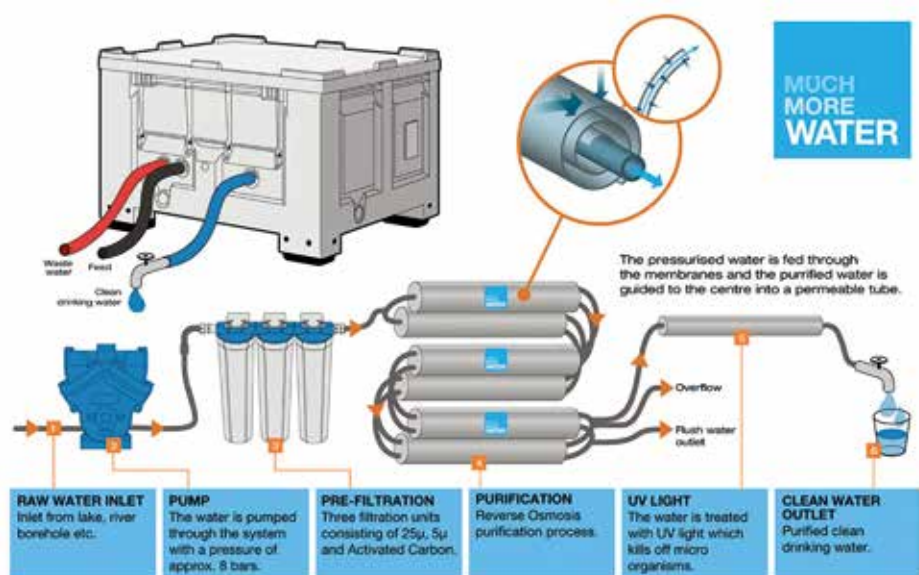


Photo: MMW

The reverse osmosis process of an RO system produced by the company MMW which eliminates unwanted contaminants in drinking water. The MMW unit has two barriers – the Reverse Osmosis membrane and the UV sterilisation lamp. The purification process will remove more than 99,5% of all contaminants, organic material, chemicals and pesticides.

Looking at the logistical requirements for water in modern conflict, it is easy to see that the demands are huge. Various military deployments in arid climates such as Iraq and Afghanistan have needed extensive deployment of support troops and contractors to ensure a viable water supply. Only a subset of the water requirements will require purification. Water for

uses adds up. Requirements will change based on the operating environment and climate.

It is important to understand the true scale of the requirements. The US Army has water planning guides that are well thought out and likely are very similar to those of other militaries. One easily available planning document published by the US Army's Quartermaster Corps, and it gives interesting planning factors. The US Army tables give daily requirements per person in the deployed force. Based on the type of operation and climate, these requirements range from 24.9 litres to 58.8 litres of potable water per person per day.

What is the Threat?

The principal threat stems from waterborne diseases, such as bacteria, viruses, and parasites. A second threat is pollution by contaminants, both artificial (for example chemicals such as fertilisers, insecticides, fuels, etc.) and natural (for example mud and particles). The severity of the threat ranges from mild to critical. Some waterborne illnesses such as dysentery or cholera can level entire armies. Before the modern era, poor sanitation often killed more soldiers than weaponry did, and modern commanders forget those lessons at their peril. In the Vietnam War, disease from water was a serious consideration and was a leading cause of hospitalisation among American troops. However, serious medical and logistical planning during that war meant that cholera was ruled out as a health threat. Waterborne illness has also been a serious consideration in more recent conflicts in Iraq and Afghanistan. A US Army study shows that, across the US military deployments in Iraq and Afghanistan from 2001 to 2007, over a million person-days were lost due to diarrhoea. Food safety, various illnesses not related to water intake (for example flu) and other sanitation issues are a large portion of this total, but some of it will be from water sources. Water purification is also essential for various purposes beyond human consumption. Boiler plants do not work well with dirty water, for example.

A secondary, but not trivial, consideration is the quality of the water post-purification. Water that looks, tastes, or smells foul, even if it meets technical standards for safety, is not good for military operations. Soldiers will drink less of it than they might need. Hygiene may suffer. Morale will suffer if poor quality water makes food taste bad. This correspondent's own experiences with over-chlorinated water during a summer of US Army training in Kansas were unpleasant indeed. Water doesn't need to be tasty, but it needs to not appear to be foul.

It should be noted that, although it does come up occasionally in defensive doctrine and manuals, the threat to water from CBRN attack is secondary. Biological warfare agents are, for the most part, the same part of the threat spectrum as naturally occurring waterborne threats, although it is possible that some biological warfare

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agents might be deliberately crafted for use in water supplies. Chemical warfare agents, such as nerve or blister agents, are a more esoteric threat against military water supplies. In general, the nerve and blister agents react with water over time, but the decomposition products are also inherently nasty substances that nobody would want to drink. Some chemical warfare agents do not readily dissolve in water. Sulphur Mustard, so-called "Mustard Gas" is actually not a gas, but an oily liquid. Drops of it may float on the top of water. Radiological and nuclear threats to water are largely in the form of particles that might contaminate lakes and rivers. Therefore, military water purification requirements must account for CBRN threats.

Chemical treatment of water is a time-honoured tactic. Soldiers can be issued with water purification tablets for treatment of locally collected water. Iodine compounds have a long history in this role. On a larger basis, chlorination of water is a long-established technique to make water safe. Once done with chlorine gas or various hypochlorite compounds such as calcium hypochlorite, newer forms of chlorination use safer chloramine compounds. Furthermore, chlorine compounds can be used to sanitise tanks



Photo: Stella-Meta

A Stella-Meta NBC FW water purification unit currently in service with the British Army

and water storage bladders. Chemical treatment of water is a well established niche in military water supply. As the products used are largely generic, the list of products and suppliers in this segment is too fragmented and lengthy for serious comment here.

Chemical treatment of water, however, has problems. On an individual soldier basis, it requires training and discipline. Water purification tablets are a local stop-gap, not a solution to the dozens or hundreds of litres a day needed to support a modern mili-

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tary force. At a technical level, it addresses only part of the threat. Chemical treatment addresses bacteria, viruses, and parasites in water but does not remove particles or dissolved chemicals. Various chemical pollutants could be left in the water, as could things like radioactive particles. Or, for that matter, minerals that make the water unpalatable.

Reverse osmosis is not without its drawbacks. ROWPUs use a lot of power. For example, the 3000 gallon per hour ROWPU used by the US military in the 1990s used a 60 kilowatt generator. (Apologies to the European reader: the US military still uses – non-imperial – gallons). From the viewpoint of some logisticians, this merely means the requirement for litres of water

issues. These factors must be taken into account when planning water supply for ongoing operations. Finally, there is a waste stream produced by any ROWPU, as everything that comes out of the clean water goes out of another part of the apparatus as sludge. In some environments, the waste effluent from a water purification unit can be highly toxic and require special disposal. ROWPUs can be fixed or mobile. Generally, the military ROWPU market is for mobile units, even though the large end of the ROWPU market is comprised of very large units that require special transport arrangements. Water storage and distribution are as important as water purification and should be considered as part of the overall approach to water purification. However, a detailed discussion of water containers, bladders, tanks, and trucks is beyond the basic scope of this article.

Looking around the world, the largest single market segment in military water purification is the US military, as with many types of military expenditure. Therefore, there is a large amount of technology and many products developed around US military requirements and budgets. These are then marketed by US producers to what they realistically but often patronisingly refer to as “the rest of the world” market. Scratch a ROWPU in the EMEA or Asia Pacific market and you might find an American MIL-SPEC somewhere. The trick, this author discovered, is to see if a given system is rated for gallons per hour (gph), the US metric of choice in measuring water output. 1 gph is equivalent to 3.785 litres per hour, or 0.832 imperial gallons per hour.

Product differentiation can be difficult in this area, as the basic output is the same – clean water. Differences between products built largely to the same specification can be slight: a wide variety of manufacturers make water purification systems for military use. Generally, anything for military requirements integrates removal of CBRN hazards into the specifications, whereas units built for civil use, such as disaster assistance, may not be rated for such use. Mostly, reverse osmosis handles such contingencies and lack of a specification for CBRN use is often due to a manufacturer not submitting a particular model for testing and/or not wanting to deal with the waste effluent.

First, there is the substantial American market, which is based on providing 600 gph, 3000 gph, and the newer, smaller “Lightweight Water Purification System” ROWPUs. Larger systems are often intended for shipboard or fixed installation usage. A basic survey of the ROWPU world shows a number of manufacturers



Foto: US Army

The US Army annually hosts the RO Water Treatment Rodeo, in which various water treatment teams compete against each other. Shown here is the 753rd Composite Supply Company team transporting equipment into the Atlantic Ocean on 12 June 2017 to produce drinking water from seawater.

By far the most significant technology and family of products in this sector are reverse osmosis water purification units (ROWPUs). ROWPUs, to use the now-prolific US military nomenclature for them, are the workhorse of military water purification. Reverse osmosis is a superior technology for deployable water purification, as it is a scaleable technology. Reverse osmosis units range from the size of a suitcase to those as big as a house. They work on a principle of passing water through membranes that only allow water molecules to pass. Reverse osmosis units tend to have either “single pass” (one pass through the membrane), or “double pass” modes, depending on the quality of the water to be processed. They have a variety of filters on the front end to deal with the mud, muck, and particulates before the serious work at the membrane begins. In theory, a good reverse osmosis unit can take a bucket of mud damp with sea water, parasites, and Mustard Gas in the front end and squeeze out a glass of pristine drinking water at the back end. It should also be noted that reverse osmosis has also replaced older technologies for desalination on many naval vessels.

is shifted over one column on their chart, to litres of fuel. But it does so at a greatly favourable ratio. The 60 kilowatt generator of the 3000 gallons per hour ROWPU’s uses about 5 gallons of diesel fuel per hour, thus equating to a 600:1 by volume ratio of water to diesel. For any logistician, this is a large gain.

Likewise, few of them are designed for continuous use. The 3000 gallon per hour ROWPU previously mentioned is quite robust, but even so is only designed to operate 20 hours a day instead of 24. They also require replacement of consumable parts, such as filters. As ROWPUs are complex machines with many working parts, both routine maintenance and emergency repair of breakdowns are important factors. Mean Time Between Failures (MTBF) statistics are usually closely held by the manufacturers, but complex machinery will have breakdowns and intervals out of service for routine maintenance. Also, the MTBF for generators supplying power to ROWPUs must be factored into planning. A US Marine Corps document refers to many generators having 24 day MTBF, so long-term provision of power to support water operations can be hobbled by power

making comparable products. AMPAC, a specialty manufacturer of water purification systems for military and civil customers, is based in Montclair, California, and produces the entire range of water purification systems, which start with suitcase-sized units that produce 10 gallons per day (gpd) all the way up to massive industrial scale 1,000,000 gpd units designed for installation on major facilities and bases. MECO, based in Louisiana, is a similar industrial player in the field, with every conceivable size of water purification device for the defence market in its portfolio. It should be noted that both AMPAC and MECO are specialty engineering companies with some military business, rather than defence contractors dabbling in water. The Pennsylvania based Terra Group, which also markets under the "Tactical Water" brand, has a product line that covers the US military requirements. Their Lightweight Water Purification System, used by the US military, is small and highly deployable and purifies 75 gph of salt water or 125 gph of fresh water. Many hundreds of systems have been procured by the US Marine Corps. The company also does larger systems, including a trailer-based 3000 gph system.

Non-American companies and customers are significant as well. Over the last few decades, deployments outside of Europe, often to arid climates, in support of various coalitions, alliances, and peace-keeping efforts have driven many European militaries to renew their emphasis on water logistics. The first Gulf War in 1991 saw some military allies of the USA turning up in the theatre of operations reliant upon US military water supplies, not all of which had been forecast by American logisticians. The UK military was faced with water needs in 2003 with the invasion of Iraq. The British Army was reliant on drilling boreholes in Afghanistan, and to a lesser extent in southern Iraq. The Yorkshire-based firm

ACWA produced equipment for urgent deployment in 2003. The firm Stella-Meta, in Hampshire provides a range of water purification equipment for UK military requirements.

Outside North America and Europe there are both markets and players. Examples are too many to list here, but Tecimer (Turkey), Rowater (Australia), and ELW Global (South Africa) are some examples out of



Photo: Kärcher Futuretech

A Kärcher RO Water Treatment Unit in operation in Ethiopia

Force projection into places with little existing water infrastructure is a requirement in many militaries. Berkefeld, a Germany-based arm of the French conglomerate Veolia produces 6 different mainstream products. For example, their BERKEFELD M6 will process up to 6 cubic metres of water an hour. (Cubic metre per hour becomes the standard metric outside US defence circles: one cubic metre equals approximately 264 US gallons.) The German firm Kärcher Futuretech, well known in CBRN circles for its decontamination products, produces about ten different ROWPU units for military or disaster response use. They also have filtration units and chlorination systems, for situations not requiring a full reverse osmosis system, as well as a variety of water storage and distribution products.

many. Bulk Handling Australia, while not a water purification provider, is a significant producer of water storage solutions for military use.

What does the future hold? Reverse osmosis is a stable and mature technology. Development of lighter, more power-efficient systems is likely as the established manufacturers seek to effect incremental improvements. Perhaps the most interesting technology is to extract water from the air. The Israeli firm Water-Gen is pushing the frontiers in this sector, and is one to watch. While such systems will never achieve the volumes of water that reverse osmosis can produce, they will fill a valuable niche in situations where little or no surface or underground water can be found. ■

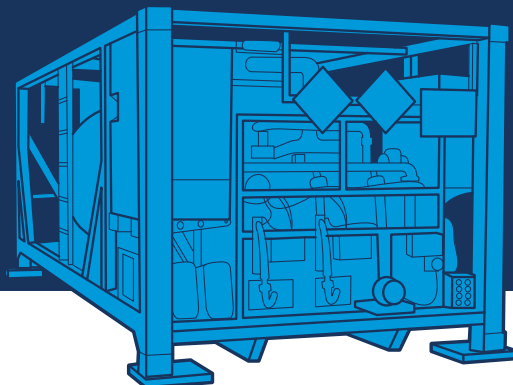
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Building a Chemical Threat Response Toolkit

Clint Wichert M.S., Director of Product Management, FLIR Detection

From accidental leaks and improper handling of hazardous materials, to an intentional chemical attack, exposure to unknown or toxic chemicals can happen anywhere. Due to the rising threat of terrorism and the myriad ways people can be exposed to toxic materials in the environment, the ability to detect and identify chemical threats is more crucial than ever.

Operators must also understand the state of the hazard (vapour, liquid, or solid) for critical on-scene response. This can inform the operator about what kind of personal protective equipment (PPE) is required, along with sample or evidence collection procedures and the selection of proper detectors.

Trace Versus Bulk Sampling




















Another important consideration is the quantity of a threat that needs to be sampled: bulk or trace.

In practice, a bulk sample can be seen and easily weighed, while a trace sample is virtually invisible. Concealed threats typically have trace residue on the exterior; therefore,

differences in sample quantities, operators can then consider what chemical response tools are required. After all, no single tool will accomplish every task. Chemical detectors vary in sensitivity and specificity, so it's important to understand the capabilities of each technology to select the right tools for the job.

Detection/Classification Tools (Least Costly)

- Colourimetric: Single-use, inexpensive tests to determine the presence of a threat and its chemical class.
- Multi-Gas Monitor: Used to detect toxic gas leaks, including carbon mon-

TECHNOLOGY		BREADTH OF DETECTION	SENSITIVITY RANGE	
			BULK	TRACE
Colourimetric				
Raman				
FTIR				
IMS				
HPMS				
GC/MS				

Photo/Graphic: FLIR



A detection specialist in PPE using the FLIR GRIFFIN G510 GC-MS

A critical line of defence is the combination of chemical threat detection tools and the personnel who operate them. But before selecting equipment in the responder toolkit, it's first important to understand the landscape of chemical hazards and their potential impact on life, property, and the environment:

- Health Hazards: narcotics, chemical warfare agents and toxins.
- Physical Hazards: Flammable chemicals, corrosive/oxidising agents, and explosives.
- Environment Hazards: Toxic industrial chemicals.

a detector with trace-level sensitivity is required. Further, many gas-phase threats can cause harm at the trace-level, so having a system that can detect minute amounts is critical.

Conversely, solid threats are typically considered bulk. Although most trace detectors can detect bulk samples, operators can expect a trade-off on system performance.

Types of Chemical Response Tools

By understanding the various types of chemical threats, the phases of matter and

oxide and chlorine. Some monitors are equipped with photo-ionisation detectors for volatile organic chemical (VOC) detection, but they are susceptible to interferants and are not confirmatory.

Presumptive Identification (Middle Cost Range)

- Spectroscopic Tools, including Raman and Fourier-Transform Infrared (FTIR) Spectroscopy: Primarily used for bulk samples, these can quickly interrogate unknown solids and some liquids, in-

cluding narcotics and explosives. This equipment is lightweight and fast, but not ideal for trace-level detection or complex mixtures.

- **IMS (Ion Mobility Spectrometry) Systems:** Quick and sensitive, IMS systems provide critical early warnings of chemical threats but are prone to frequent false positive readings due to sample overloading and environmental effects.
- **High-Pressure Mass Spectrometry (HPMS):** An emerging technology, this tool only uses mass spectrometry for analysis. It has similar benefits and drawbacks to IMS, but enables larger libraries and greater data processing along with fewer false alarms.

Confirmatory Identification (Most Costly)

- Portable or lab-based Gas Chromatography–Mass Spectrometry (GC-MS): A

gold standard technology, GC-MS tools analyse complex samples, including vapour, liquid, and solid-phase chemicals. Although the most expensive, GC-MS is selective and sensitive while offering the broadest capability, making it the ultimate confirmatory tool.

Consider Chemical Libraries

Chemical libraries are the software, electronic, or colour change-based templates for the responses of certain chemicals. Libraries range in fidelity from a colour shift on pH paper to electronically matching the mass fragment chemical fingerprint. When determining the appropriate tools, review the missions and types of threats encountered. Some operators may consistently respond to the same 10-15 threats, suggesting a colourimetric tool might work best. For others, the ability to identify unknown chemicals is mission critical.

Ease-of-Use And Survivability

In addition to detection capabilities, it's just as important to consider the specific conditions and scenarios in which a given tool and its personnel may be placed. Hazardous environments demand tools that are not only easy to use, especially when individuals must operate quickly while wearing PPE, but can also survive extreme conditions.

Determining the Toolkit

With all the factors listed above, governments and organisations responsible for chemical detection must also consider costs, the required coverage area and personnel training. Only then can they take the appropriate steps required to create a truly effective chemical detection toolkit.

In the end, the right toolkit can be the difference between a catastrophe and a rapid response that helps keep the public and personnel safe from harm.



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Digitisation of Land Forces: The Military Embraces 4IR

Tamir Eshel

The integration of communications and information is driving a worldwide transition that is being termed the Fourth Industrial Revolution. Armed forces and security organisations around the globe are embracing this transformation, by fielding digital communications networks and interconnected systems of systems, empowered by information services.

The capabilities they deliver empower military forces, enabling smaller forces to deliver big, decisive actions. This article examines some of the elements of such networks and the systems and services they enable.

At the same time, the military was slow to convert because of the huge investments in acquisition and deployment of military specific systems, rapid obsolescence of such systems, and complexities address-

ing common waveforms, rather than identical equipment to ensure interoperability and information sharing, an essential capability for operations within joint forces and between coalition partners. Frequent over-the-net upgrades enable users to respond to evolving challenges and address new threats by updating equipment with new algorithms and software patches on the fly. With waveforms becoming common among military users, more agile forms of communications are introduced, supporting highly robust, secure information transfer methods designed to be resilient in complex environment and more immune to interference and jamming.

The SDR Revolution

SDRs have grown to become a significant change agent for defence systems and military organisations. Primarily, those radios provide a robust and reliable alternative to traditional two-way communications, by enabling better, more dependable communications with narrower VOIP channels, thus improving spectrum utilisation. Additionally, with baseline communications going digital, a single radio set could support multiple voice and data channels, secured and encrypted, offering more efficient use of available assets. By implementing advanced waveforms, standard radios can now act as repeaters, point-to-point links or as members of Mobile Ad-Hoc Networks (MANET), establishing seamless, flexible, self-formed, self-healing networking in areas where other means of communications do not perform reliably. A major advantage of these new radios is maintaining compatibility and interoperability with hundreds of thousands of combat-net-radios sold worldwide. Traditional equipment offered military personnel the ability to tune into a single preferred frequency and supported only one protocol. With SDR, users can monitor and



Photo: Elbit Systems

Elbit Systems' E-LYNX is a typical SDR supporting multiple voice sessions and data transmissions.

A prominent step in this direction is the modernisation of communications systems from analogue, voice-based radio and telephone systems to digital systems, utilising Voice-Over-IP (VOIP) internet protocols. This move began in the 1970s, with the introduction of IP technology that provided the basis for the internet in the 1990s and revolutionised the global commercial telecommunication in the 2000s. The commercial world was quick to adapt the new technology, given the huge commercial values it delivered. At

the same time, the military was slow to convert because of the huge investments in acquisition and deployment of military specific systems, rapid obsolescence of such systems, and complexities address-

Software-Defined Radios

The introduction of Software-Defined Radios (SDRs) in the early 2000s changed the radio communications paradigm by producing radio transceiver hardware and supports standard-based software. It enabled users to leverage equipment for years, by updating and upgrading the 'operating system', rather than replacing major electronic subsystems in a complex and expensive upgrade. This software upgrade method is similar to the operating system update on mobile phones and PCs. Moreover, with radios covering larger bandwidths than their predecessors, users can rely on

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Photo: US Army

The satellite-based WIN-T network enables military users to integrate an 'everything-over-internet' protocol to provide connectivity across an extended, non-linear battlefield and in locations.

communicate over a large portion of the spectrum (typically HF-VHF-UHF-L Band) while supporting multiple protocols. Operating in various protocols enables military SDR sets to link different domains such as land forces, pilots or naval units, through terrestrial, airborne and satellite-based networking. They harness all available connectivity means, including Bluetooth, CDMA, GSM, LTE or WiFi, along with specific services unique to the military service of coalition. Specific gear and waveforms are also employed, for example, to establish low-latency connectivity necessary for real-time applications such as targeting and remote control.

SDR has come a long way since the early days when computing technology limited the amount of processing, and therefore the capabilities of SDR. Modern radios are highly secured network-controlled devices that can be programmed and updated on the fly. Although they employ common hardware and software modules, different systems are offered to address specific user needs, as part of a "family of radios" each offers unique advantages.

A typical SDR supporting multiple voice sessions and data transmissions, as well as backward compatibility to legacy waveforms is Elbit Systems' E-LYNX, a radio family that provides the essential element for cross-network integration. Operating simultaneously on a single physical channel, E-LYNX enables users to communicate in several voice networks at the same time, and independently transfer data, reducing the number of single channel radios on board, along with the associated antennae, cables and power consumption. It also eliminates co-location interference gener-

ated by multiple radios on board and simplifies spectrum allocation management. Like other tactical SDRs, the E-LYNX wireless solution provides frequency coverage from 30 MHz to 1.8 GHz with multiple waveforms. It is available in high-power dual- or single-channel vehicular/airborne and manpack sets and down to handheld



Photo: Rhode & Schwartz

SDRs are part of Rhode & Schwartz' SOVERON architecture, supporting tactical communications scenarios and for deployment on airborne platforms. The family includes SOVERON D, which is the product created under the joint radio system project of the German Armed Forces (SVFuA).

and personal role soldier configurations. A major advantage is its extended networking coverage, particularly over harsh terrain, using multi-hop concurrent flooding technique that improves spectral usability and efficiency and immunity to interference. New configurations released last year include lighter, compact, low-power-consumption manpacks and a new configuration of vehicular sets that easily integrates into modern combat vehicles.

Having a digital two-channel radio is a major advantage to dismounted unit leaders who, until now, relied on three radios to

perform their job. The new radio set can support two channels simultaneously, with secure voice and simultaneous data transfer. Full motion video comes as an extra bonus that previously required dedicated communications gear. A two-channel radio means troops can carry fewer radios and spare batteries, thus reducing their loads.

Satellite Based Networks

While terrestrial networks are effective supporting land operations, their coverage is limited by terrain, jamming and interference that requires careful planning to minimise crossband interference. To maintain such communications, military forces have established dedicated networks designed for expeditionary and deployed operations. Such networks are adapted to support the specific military doctrine and represent a significant capability and investment that cannot be replaced as frequently as commercial communications technology. Satellite-based communications networks are available to support global connectivity as well as link units across mountainous area or in urban terrain that hampers land-bound communications even at close range. However, unlike standard radios,

satellite terminals require highly trained specialist operators and technicians that are rarely available with tactical units. For this purpose, the US Army invested in the Warfighter Information Network – Tactical (WIN-T) Program of Record developed and produced by General Dynamics Mission Systems. WIN-T provides reliable, secure, and seamless communications for units operating at theatre level and below.

The satellite-based WIN-T network enables military users to integrate an 'everything-over-internet' protocol to provide connectivity across an extended, non-linear battle-

field and at remote locations. The network was designed to deploy over a period of 30 years in four increments. The first increment was fielded in 2002 and established rapidly deployable means to exchange voice, video, data, and imagery between command posts using compact, mobile Ku-band and Ka-band satellite-based network terminals mounted on vehicles. As the terminals were limited to stationary positions, this increment was referred to as 'Networking at-the-Halt'.

The second increment was introduced in 2012, providing mobile communications capabilities at the division level and below, providing manoeuvre commanders with initial 'command and control on-the-move'. Increment 2 uses vehicle-mounted directional SATCOM terminals that can operate when vehicles are moving. Supporting units from battalion to company level, WIN-T Increment 2 improved command and control and secure communications within manoeuvre brigades. The command vehicles carrying those satellite terminals include M-ATV, STRYKER and HMMWVs acting as a 'Point of Presence' (PoP) employing ra-

dios with terrestrial Highband Networking Waveform and a satellite Network Centric Waveform to reach back to the satellite network and distribute information to nearby users.

The third increment of WIN-T was supposed to support full networking on the move by 2020 but this phase was terminated as the Army decided to pursue more versatile networking assets for the tactical level. 'Full Networking on-the-Move' was to provide full mobility mission command for all Army field commanders, from theatre to company level using networked airborne communication relays.

One of the most pressing challenges to military network operators is the limited

bandwidth capacity they provide to users. Unlike commercial activities that are carefully planned, coordinated and regulated by government and international organisations, military communications are designed to operate in a chaotic operating environment dominated by inconsistent connectivity due

to enemy actions, loss of assets and the need to maintain mobility and survivability. On the other hand, the demand for bandwidth is ever increasing, with user reliance on video and real-time information.



Photo: Bittium

The Finnish Defence Forces (FDF) have selected the TAC WIN IP networking solution from Bittium for its new Tactical Wireless IP Network.

Militarised Communications Networks

To enable deployed military networks to evolve at a rate closer to those of the commercial world, many armies turn to 'militarised' 4G LTE technology, coupling the military communications environment with commercially based ruggedised equipment. The Finnish Defence Forces (FDF) have selected the TAC WIN IP networking solution from Bittium for its new Tactical Wireless IP Network. The decision to modernise the network was part of the FDF reorganisation, enabling its land force to employ smaller, better-equipped mobile combat units that can manoeuvre on larger areas and effectively en-

gage an enemy with better results than former linear forces. Smaller, more manoeuvrable units require an equally agile network that could only be enabled by SDR technology and all-IP tactical networks.

This ambitious goal required significant investment in digital network technology, and a practical approach was to utilise hardware and protocols, but also technologies such as cognitive radio, MESH networks, and adaptive antenna concepts developed for commercial applications. Research and development in waveform development also leverage efforts made by other NATO members that shared the European Secure Software Defined Radio (ESSOR). In addition to voice and networking, the system should support

situational awareness and broadband data in addition to delivering messages across all units and throughout the entire operational area, even in areas not covered by the fixed, terrestrial network.

The system supports multiple network topologies, including point-to-point (P2P), point-to-multipoint (P2mP) and more complex mobile ad-hoc network (MANET) configurations. This gives the user the flexibility to adapt the network to the situation, which means higher tolerance to any threat that might block a link connection or disable network nodes.

Networked Applications Driven by Digital Communications

As smartphones transformed our daily life, C2 apps transform military command and control. Such apps are deployed quickly and change frequently, enabling designers and users to adapt their user interface and operation to meet soldiers' likes and needs.

Leveraging such capability, the US Army has recently tested two mission command 'apps' called MCE (Mounted Computing Environment) and MMC (Mounted Mission Command) to compare user experience with different apps that reduce network complexity and provide soldiers with an intuitive system. Both systems were evaluated in November 2018, during the Network Integration Experiment (NIE 18.2) event. Soldiers received the systems and operated them in simulated combat, as the systems were rated on metrics ranging from message completion rate, bridging multiple networks simultaneously, cybersecurity posture, interoperability and backwards compatibility with currently fielded army systems.

The US Army began developing MCE in-house but soon realised emerging commercial solutions would best meet its needs. MCE was developed by the Army using the government-developed Android Tactical Assault Kit (ATAK) app to provide simple and intuitive Mission Command on-the-Move and situational awareness down to the tactical edge as part of the Army's common operating environment. It leverages the existing Joint Battle Command-Platform (JBC-P) hardware and network and will eventually replace JBC-P software on the Army's Mounted Family of Computer Systems Hardware and the Blue Force Tracking 2 SATCOM network.

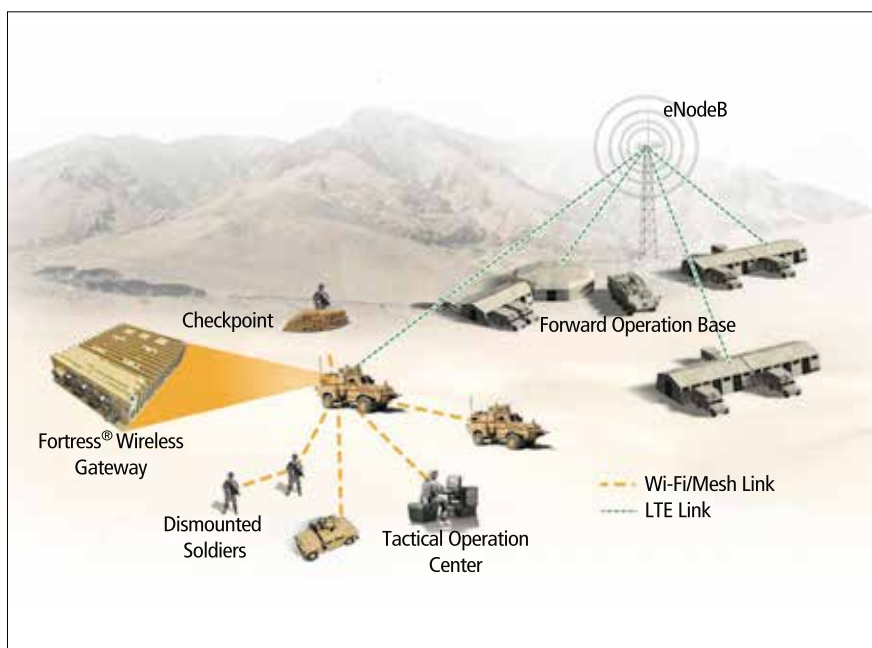
The second app, MMC, is based on Frontline v2.0, a commercial product of the SitaWare brand from Systematic.

The company's applications are also part of the US Army's Command Post Computing Environment (CPCE) to be fielded this year with the first Army unit. CPCE is a package of hardware and software to improve command and control and minimise the command post's physical and energy footprint. Units accessing the command post computing environment will be able to drop graphics into maps, share documents or chat with soldiers in the field, facilitating increased lethality.

CPCE is a new capability being introduced by the Army under the Integrated Tactical Network (ITN) concept that utilises military, militarised and commercial elements in a network designed to be resilient and operate in a contested environment. Rapid development and deployment of the new network is a high priority for the Network Cross Functional Team (N-CFT), an agile research, development and acquisition organisation launched last year by the newly established US Army Futures Command. The first increment of ITN is expected to become operational in 2020. Future enhancements will include utilisation of low-earth-orbit satellites, new waveforms, cross-domain solutions and artificial intelligence/machine learning, as emerging technologies become available.

Components of the ITN include existing single-channel and two-channel leader radios with advanced networking waveforms, handheld Link 16 radios, small aperture satellite terminals, as well as commercial systems such as 4G/LTE/Wi-Fi and smartphone-based end user devices. General Dynamics Mission Systems provides such a network system with its FORTRESS Wireless Network solution. The system utilised Mesh and 4G LTE products designed for optimal size, weight, power, cost and outdoor use, and customisable for specific frequency bands to fit a variety of mobile applications from tactical deployments through to cluttered urban environments.

The wireless gateway is a vehicle-mounted networking module allowing users to connect quickly and securely to a wireless network to enhance and extend wireless network coverage. Designed as a secure communications gateway for tactical use, it provides connectivity, roaming and mesh networking capabilities extending cellular networks over the licensed and unlicensed spectrum, for Wi-Fi and LTE networks. Users can also connect their existing mobile devices, like smartphones, cameras and tablets to the network via the Wireless Gateway.



Graphic: General Dynamics

General Dynamics' FORTRESS Wireless gateway is a vehicle mounted networking module allowing users to connect securely to a wireless network to enhance and extend wireless network coverage.

One of the important advantages ITN introduces is a 'secure but unclassified' (SBU) service level, being more suitable for tactical users. Unlike highly encrypted military networks that support Secret level and above, ITN is designed for tactical use at battalion level, where secrecy is time-sensitive and therefore becomes unclassified after a while. Therefore, having high security becomes a liability, rather than an advantage. Utilising less powerful encryptions, SBU leverages a combination of military and commercially available networks and security measures that offer more flexibility by using all available networks. While SBU information is not classified, the ITN's multiple layers of encryption protect data transmitted over military or commercial networks, the internet, cellular networks or compatible but non-military waveforms. Other benefits include simplified training, setup and employment of the network, which speeds up planning time and creates a more collaborative planning environment, including communications with joint and coalition partners.

Data-Driven Ecosystems

Utilising standard-based communications, the military flattens the networks, introducing more competition. Responding to the competition, companies specialised in military communications tighten their service offerings by leveraging radios, waveforms and applications to provide users with an easily deployed 'ecosystem' that can instantly deploy on their networks.

Powered by highly integrated networking, Harris FALCON NET provides such data-centric services to offer converged voice, data and full motion video interoperability throughout the FALCON family. Supporting over 50 waveforms over SDRs, FALCON NET enables users to cope with demanding operational environments, through low latency, anti-jam, and mobile networking. As part of that ecosystem, Harris also offers applications previously implemented by users or third-party providers. Such applications support anything from basic chat and messaging and position location reporting, to battle management, common operating picture, network planning and monitoring design. Relying on a single provider for 'everything digital' may be risky but help ensure the success and 'future proof' of such programmes.

Summary

Significant increases in defence spending among most of the NATO and European members reflect the growing need for force modernisation. The future force may not be bigger or stronger, but far more agile, empowered by modern digital networks, providing the dynamics bringing the total force to effect. Modern digital communication is the enabler for such capabilities. Carrying voice, data and video to bond individual units with weapon systems and supporting elements, such communication is essential to turn multinational forces and joint commands into cohesive combat forces. ■

Arctic Tests of the BRONCO 3 Completed

Gerhard Heiming

Currently, ST Engineering Land Systems is finalising the development of the BRONCO 3 vehicle. For the end of a test campaign lasting several weeks, ST Engineering invited interested parties from Europe, America and Asia, as well as international specialised journalists, to Ivalo/Finland – 300 km north of the Arctic Circle – to present and demonstrate the performance of the vehicle under Arctic conditions.

The BRONCO 3 can cross rough terrain with low bearing capacity without preparation thanks to its particularly low ground pressure (0.3 bar) at 16 tonnes combat weight and its unusual articulated steering. The vehicle can transition from soft to swampy ground to water without external support. Propelled by

Development in the BRONCO Family

The development of the BRONCO 3 was based on lessons learned in missions with its predecessors, including the BRONCO 2, which the British Army deployed to Afghanistan as WARTHOG. The central de-

tracks improved the ballistic protection against mines/IEDs while providing more space for the crew. The front body of the latest BRONCO version has an interior volume of 5.9 m³ and the rear body 7.9 m³, with an interior height of 1.25 m, which allows for more efficient crew operation. In the passenger transport version, the BRONCO 3 offers space for five (front) or eight (rear) soldiers; the rear seats are attached to the side wall and fitted with footrests to protect against blast.

For protection against mines, the underbody of both vehicle bodies is a continuous, V-shaped armour steel plate. The rear car has a ground clearance of about 1 metre. The cabin walls are made of armoured steel to protect against ballistic threats. The ba-



Photo: Heiming

The articulated, two-body BRONCO 3 successfully completed Arctic tests.

tracks, the fully amphibious vehicle can swim at speeds of up to 5 km/h. On firm ground, the vehicle – powered by a Mercedes-MTU TD 106 diesel engine (Euro 3) – reaches a top speed of 65 km/h. The vehicles of the BRONCO family are steered by an articulated joint connecting the two bodies of the vehicle. The four tracks are all driven at different speeds during steering

velopment goal was to reduce its empty weight by two tonnes while maintaining its protection level by optimising the structure and using lighter components. Buoyancy was not to be impaired by the payload of four tonnes. On land, it should be possible to increase the payload by two tonnes (combat weight 18 tonnes) in a system-compatible manner. A new stowage concept and not placing the seats above the

Nominal Ground Pressure

Nominal ground pressure (NGP) and combat weight are the two most important characteristics to assess the off-road capability of a combat vehicle. A common method to calculate NGP is the ratio of combat weight to track contact area. The latter is the product of track length on ground and track width. On solid ground, the NGP is higher, because only the raised parts of the track profile are in contact with the ground. On soft ground, the NGP decreases with the sinking depth until the hull rests on the ground.

A marching infantryman with 120 kg (combat equipment included) generates an NGP of approx. 0.7 bar, a modern medium battle tank like the LEOPARD 2 A7 V comes to 1.0 bar, the NGP of an 8x8 wheeled vehicle – depending on tyre type and adjusted air pressure – achieves more than 2.0 bar. The 0.3-bar NGP of the BRONCO is below all them.

sic protection is level 2a/2b according to STANAG 4569 and can be increased to level 3 (ballistic only) when required, at the expense of available payload. For self-protection, a remote-controlled weapon station can be integrated on the roof with a heavy (12.7mm calibre) machine gun about which ST Engineering has not given further specifications.

The running gear uses a Soucy Composite Rubber Track (CRT). Standard width is 0.6 m, but wider tracks of 0.65 m or 0.7 m can be mounted in order to maintain the low ground pressure when increasing the overall weight. The 0.65 m track has different track profiles to increase climbing ability, for example, in mountainous areas. Depending on the driving style and ground conditions, the tracks achieve a mileage in the order of 6,000 km, and changing them requires maintenance personnel and special equipment.

In order to be able to operate the electronic equipment required in modern warfare, for example, for observation, reconnaissance, command and control and communication, a generator supplies 550 A at 24 V; the vehicle concept envisages the integration of an additional power generator (Auxiliary Power Unit, APU). Power and data are distributed via an open electrical architecture that is compatible with the Generic Vehicle Architecture (GVA). The standard BRONCO 3 is equipped with a front and rear camera system that supports the driver in driving the vehicle and provides the entire crew with information on the situation in the immediate vicinity of the vehicle.

A special feature of the rear body is the consistent division into chassis and mission structure; this allows the rear body to be equipped for other missions in a short time via quick connectors. Next to the standard cabin for passenger transport, which

ST Engineering

ST Engineering Land Systems is part of the engineering and defence group ST Engineering, which employs 22,000 employees in 100 countries. In 2018, the group's four divisions accounted for revenues of US\$5B: Aerospace (39%), Electronics (32%), Land Systems (19%) and Marine (9%). Defence activities make up about one-third of the revenues. Most customers are located in Asia (62%); 20% are from the US and 11% from Europe.

The product spectrum of ST Engineering Land Systems includes among others tracked (BRONCO) and wheeled (TERREX) vehicles, soldier systems (ARIELE), robotic systems, small arms, weapon stations, mortars and howitzers, as well as ammunition, special vehicles and technical services.



Photo: Heimring

The articulated coupling is the one of the basic features of BRONCO 3

features mounting rails to rapidly change devices depending on the mission, ST Engineering also offers an open box and a flatbed for logistics transport. ST Engineering has developed numerous other variants with special equipment for reconnaissance, combat (with increased protection, a weapon station and extended range), indirect fire, medical evacuation and treatment, as well as recovery and repair.

The BRONCO DAWN is a highly mobile mortar system; the front body features a radar for reconnaissance, target tracking and identification friend-or-foe (IFF), a shot detector, a remote-controlled 12.7mm weapon station and the rear body an automatic 120mm mortar. The system can detect slow-flying objects with a low radar cross-section, such as unmanned aerial systems, gliders and helicopters and engage them with the weapon station.

The Arctic tests in Ivalo are at the end of the company's trials; final tests in hot weather will follow. From ST Engineering's point of view, the BRONCO 3 is ready for series production. Production can start at short notice, with a rate of eight vehicles per month. If required, the rate can be doubled in two-shift operation.

The Next Step

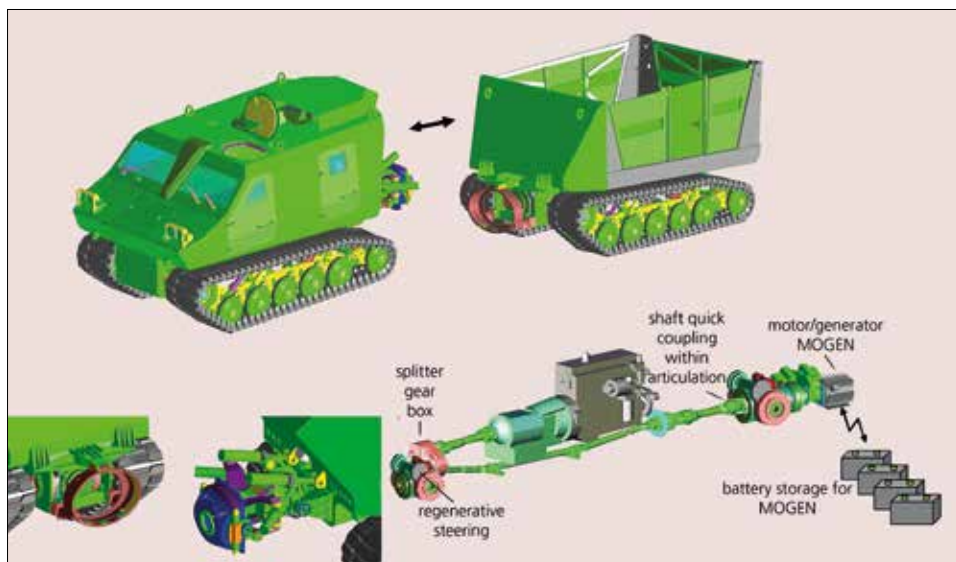
The next development step has been initiated and has reached the prototype stage; ST Engineering has introduced a patented diesel-electric hybrid drive for autonomous operation of the rear body.

The rear body is fitted with batteries in the chassis and an engine/generator (MoGen), which is driven through the articulated joint



Graphics: ST Engineering

The BRONCO 3's modular design provides a high level of flexibility, facilitating quick and easy mission module switching.



Hybrid drive is provided by a combustion engine in the front body and a motor/generator with batteries in the rear body.

in (coupled) normal operation and charges the batteries with a portion of the power of the main engine in the front body. In this operating mode, the steering takes place unchanged via the articulated joint with the tracks running at the same speed. For silent driving, the main engine can be switched off and – due to the CRT being quiet anyway

– the BRONCO 3 can approach its position almost silently with the electric drive. The electric drive in the rear body also allows it to be operated autonomously (Manned-Unmanned Teaming, MUT). For this purpose, the two bodies need to be disconnected, which takes a few seconds. New steering gears in both cars enable power

transmission between the inner and outer tracks for regenerative steering, so that the rear body can be positioned by remote control alone via an autonomous set to bring sensors or weapons into position without endangering the crew. The energy supply will allow a range of up to 20 km depending on battery size.

Market

ST Engineering sees opportunities to market the new BRONCO 3 to armed forces; the company had invited specialist personnel to the demonstration. However, sales opportunities are also seen in nations which want to replace the BV206, introduced decades ago with the same vehicle concept. Experiences gained in disaster operations – such as the snow disaster in Germany in early 2019 – show that the built-in protection can also reduce the risk of falling trees or debris. For this reason, civilian disaster prevention officers are also part of the target group. Japan, for example, uses the EXTREM V – the commercial variant of BRONCO – for this purpose. To date, ST Engineering has sold around 1,200 BRONCOs in over 20 versions; the new BRONCO 3 offers the opportunity to increase sales further. ■

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Fleet Replenishment Ships: the Workhorses of Many Navies

Guy Toremans

Although underway replenishment and fleet sustainment are often regarded as the less glamorous aspects of maritime operations, logistic support vessels are one of the most critical factors for a successful employment of naval assets.

Having to contribute to an ever wider variety of missions, a number of naval forces are recapitalising their afloat logistics capabilities with more versatile platforms that offer not only a replenishment role but can carry out a myriad of other services. ESD takes a look at the European support vessels market, where, as of end-2018, some 22 new replenishment ship projects for 13 European navies were in the pipeline.

Bulgaria

The Bulgarian Navy's (Voennomorski Sili) two 1,270-tonne support oilers BALCHIK and AKIN, which entered the fleet in 1994 and 2000 respectively, are not suited to comply to their NATO commitments. Hence the sea service's requirement for a more capable replenishment ship to replace both support tankers. It is anticipated that the Bulgarian Navy may either attempt to procure a second-hand logistic support ship from a NATO nation or purchase a newly built platform, the latter likely to be constructed at one of Bulgaria's shipyards in Varna or Bourgas. In case the navy opts for an in-use ship, the vessel could be selected as early as 2022. If the new construction option is selected, the contract will probably be in place by the end of this decade.

Croatia

The Croatian MoD's "Long-Term Development Plan 2015–2024" set out the navy's (Hrvatska Ratna Mornarica) maritime programmes, including the procurement of up to four new offshore patrol vessels anticipated to enter service through the late-2020s, and the acquisition of a supply ship to provide logistic support to these new



The Turkish Navy's fleet support ship (AORH) TCG AKAR

units. The design development is anticipated to start in 2025 in order to have the construction contract signed by 2027 for a commission by 2030.

France

Although France's overseas departments assure the French Navy (Marine Nationale) of a number of ports where it can refuel and replenish its ships; the sea service maintains an underway replenishment capability with its three 18,797-tonne DURANCE class replenishment tankers FS VAR, FS MARNE and FS SOMME, commissioned in 1983, 1987 and 1990, respectively. Under the 'Flotte Logistique' Programme (FLOTLOG), the navy plans for their replacement by three new logistic supply ships. Initially, Naval Group (ex- DCNS) was the frontrunner, offering its 205 m long Bâtiment Ravitailleur d'Escadre (BRAVE) concept. Displacing approximately 30,000 tonnes, the BRAVE design features two replenishment-at-sea stations on each beam for fuel and dry stores, a helicopter deck and hangar for two mid-sized helicopters, facilities for vehicles, containers,

small landing craft, rigid-hulled inflatable boats (RHIBs) and also suitability for use as a command platform. However, on 10 April 2017, the French MoD decided to select the Italian Fincantieri's VULCANO design, currently under construction for the Italian Navy. This decision was followed by the formal purchase of 50% of STX Shipyard France by Fincantieri in February 2018. The construction could commence as early as 2020, with deliveries scheduled for 2023, 2025 and 2026.

Germany

As Germany takes a bigger role in NATO and EU maritime operations, the German Navy needs a larger replenishment force to sustain its ships operating in key strategic areas around the world. Consequently, the sea service will replace its two 1974-vintage replenishment tankers FGS RHÖN and FGS SPESSART, with two new fast combat support ships to supplement the three BERLIN class combat stores ships already in service. Due to the navy's higher priorities, such as the Type 212A submarines, the additional

Author

Guy Toremans is a freelance naval journalist based in Belgium.

Photo: Guy Toremans



The Greek Navy's support ship (ARL) HS AXIOS, the former German FGS COBURG

K-130 corvettes, the BADEN-WURTEMBERG class and MKS-180 multipurpose surface combatants, the new fast combat support ships, expected to be quite similar to the BERLIN class, may probably be ordered by 2025 with their commissioning anticipated in 2029 and 2031 respectively.

Greece

Currently, the Hellenic Navy's inventory of replenishment ship consists of the 13,615-tonne replenishment oiler HS PROMETHEUS, based on the Italian ETNA design and delivered in 2003, and the two 1968-vintage AXIOS class support ships HS AXIOS (ex-FGS COBURG) and HS ALIAKANON (ex-FGS SAARBURG) purchased from the German Navy in 1991 and 1994 respectively. It is estimated that the navy will decommission the two 4,487-tonne AXIOS tankers in 2020 and replace them with one auxiliary oiler replenishment vessel, either a newly built platform or a sec-

ond-hand support ship purchased on the international market.

Italy

With Italy more strongly supporting its European Union and NATO allies in 'out-of-area' missions, the Italian Navy (Marina Militare) needs larger supply ships in order to extend the operational capacity of its assets beyond the Mediterranean. In 2013, the Marina Militare began looking into a replacement for its two 8,650-tonne support ships ITS STROMBOLI and ITS VESUVIO, commissioned in 1975 and 1978 respectively. The navy selected Fincantieri's Unita di Supporto Logistico (USL) design. The construction of the USL – christened ITS VULCANO – kicked off on 9 February 2016. With a length of 192.2 m and a displacement of approx. 27,200 tonnes, the ITS VULCANO is the largest support ship ever built for the Italian Navy. Designed to provide a five-ship strong naval task group,

the ITS VULCANO is equipped with four refuelling stations (two each side) for liquids, two stations (one per side) for heavy load transfer, two stations (one on each side) for light material and one aft refuelling station for fuel only. In terms of cargo capacity, the ITS VULCANO can transport up to 8,700 cubic metres of F36 marine fuel, 3,700 cubic metres of F44 JP5 aviation fuel, 800 cubic metres of fresh water, 220 tonnes of ammunition, 15 tonnes of lube oil, 30,000 food rations, and 20 tonnes of spare parts. It also features multipurpose workshops as well as technical workshops in the helicopter hangar that can provide full Level 2 maintenance. The ship is also outfitted with a NATO Role 2 medical facility. Once commissioned into the fleet, scheduled for the first quarter of 2019, ITS VULCANO will provide the prerequisite for the Marina Militare to undertake a wide variety of national and international missions. Apart from providing fuel and stores, the ship will be capable of conducting fleet repair assistance, acting as a command platform, supporting mine countermeasures vessels, and undertaking disaster or humanitarian relief operations.

Although the Italian MoD has already outlined the requirement for an additional USL to replace the ITS VESUVIO, there are no indications on the procurement timeline.

The Netherlands

The Netherlands' "2018 Defense White Paper" outlines that the Royal Netherlands Navy can acquire a second Combat Support Ship (CSS) to supplement the joint logistic support ship HMNS KAREL DOORMAN that entered the fleet in April 2015. Requiring a proven design, this new combat support ship could be one of Damen Schelde Naval Shipbuilding's (DSNS) newly designed Logistic Support Vessel Replenisher (LSVR) platforms: either the LSVR 20,000 type which is a 187-metre-long platform displacing approximately 20,300 tonnes or the 175-metre-long LSVR 19,000 type with a displacement of around 19,000 tonnes. With the construction contract expected in 2023, with commissioning anticipated for 2027. The new combat support ship is likely to be built at DSNS in the Netherlands or at DSNS's shipyard in Galatz, Romania.

Norway

In 2006, the Norwegian MoD approved the procurement of a newly built Logistics Support Vessel (LSV) for the Royal Norwegian Navy. The Norwegian Defence Logistics Organisation (NDLO) initiated the plans for the new platform, codenamed Project

Photo: Guy Toremans



The Polish Navy's Project ZP-1200 tanker (AOL) ORP BALTYSK

Chantiers de l'Atlantique and Naval Group to Build Four Naval Replenishment Tankers for the French Navy

A temporary consortium of Chantiers de l'Atlantique and Naval Group was commissioned to build four Logistic Support Ships (LSS) and maintain them for the first six years. This contract for the French Navy is part of the Franco-Italian LSS programme led by OCCAR, Organisation for Joint Armament Cooperation, on behalf of the DGA, the French Defence Procurement Authority and its Italian counterpart NAVARM. The delivery of these ships will take place between 2022 and 2029. A signing ceremony was held today with stakeholder representatives. These tankers, with a tank volume of 13,000 cubic metres, will provide logistical support for the combat vessels of the French and allied navies. They will transport fuel for ships, kerosene for aircraft, weapons and ammunition, spare parts and food. The ships will also be equipped with disposal solutions and repair shops.



Photo: Chantiers de l'Atlantique

Their characteristics will adapt as well to their specific missions in support of the aviation group constituted around the aircraft carrier CHARLES DE GAULLE.

The design of the vessels will be based on the Italian LSS VULCANO (already under construction by Fincantieri), the first ship of the Italian–French Logistic Support Ship (LSS) programme managed by OCCAR. The industrial organisation of this major programme will mobilise the industrial capabilities of both nations.

Main characteristics of the vessels:

Gross tonnage: 28,700 GRT

Dimensions: 194 x 27.4 metres

Crew capacity: 190

Deadweight: 14,870 tonnes

Freight volume: 13,000 cubic metres

Armament: 40mm guns

CMS: POLARIS Combat Management System

Norwegian Navy on 16 November 2018. Following the completion of her sea trials in South Korean waters, she is scheduled to arrive in Norway during first trimester 2019. HNoMS MAUD will provide the basis for the Royal Norwegian Navy's new mission spectrum, providing nearly all kinds of material to a task force for the Norwegian Task Force, serve as mothership, with mooring and fendering arrangements for submarines, small craft and frigates, submarines, corvettes, MCM-vessels or special forces, act as a command platform, or undertake humanitarian assistance and disaster relief (HA/DR) operations.

Poland

Although refitted in 2013, the Polish Navy (Marynarka Wojenna) has a pressing need to replace its 1991-vintage replenishment oiler (AORL) ORP BALTYSK by a modern support ship. With its length of 84.4 m and displacing 3,098 tonnes, the ORP BALTYSK cannot comply with the navy's requirements for a modernised naval force, nor with the requirements of NATO, including as part of the NATO Partnership for Peace initiative. One of the likely designs considered is the Remontowa Marine Design and Consulting RMDC 3227 concept, but the navy could also choose a foreign supplier for a design that will probably be constructed at the Polish Gdynia Naval Shipyard. With a length of some 130 m, the RMDC 3227 platform displaces about 12,000 tonnes and mounts two replenishment and three heavy lift stations, the ability to transport TEU containers and embark a command facility. The navy is expected to select the design by 2024 with an anticipated in-service date of 2030.

2513. In March 2013, South Korean Daewoo Shipbuilding & Marine Engineering Co. Ltd's (DSME) BMT AEGIR 18NR design was downselected and the construction contract was signed on 28 June 2013. The first module of the LSV – christened HNoMS MAUD – was laid down at the DSME Shipyards in Okpo, South Korea, in September 2015 and the ship entered her natural element on 4 June 2016.

The 183 m-long ship features two replenishment-at-sea stations on each side, an astern refuelling capability, and a flight deck designed to operate medium- and heavy-sized helicopters. Her cargo capacity includes up to 6,000 tonnes of liquids, 900 tonnes of dry stores, a capacity to embark containers and/or different types of vehicles and medical facilities allowing her to act in a Role 1 capacity, extendable to a Role 2.

HNoMS MAUD was handed over to the



Photo: Guy Toremans

The Swedish Navy's support ship (AG) HSwMS CARLSKRONA

Portugal

The Portuguese Navy is pushing for a new replenishment ship to replace its 11,707-tonne replenishment tanker NRP BERRIO – the ex-RFA BLUE ROVER, commissioned into the UK Royal Fleet Auxiliary in July 1970 and purchased by Portugal in March 1993. With various European navies replacing their support ships, the Portuguese Navy could either join one of these

COUNTRY	In Service	Under Construction or Projected
Belgium	1	-
Bulgaria	2	1
Croatia	-	1
Denmark	2	-
France	3	3
Germany	5	2
Greece	3	1
Italy	3	2
Latvia	1	-
Netherlands	1	1
Norway	-	1
Poland	1	1
Portugal	1	1
Romania	2	-
Spain	2	-
Sweden	2	1
Turkey	3	4
Ukraine	1	-
United Kingdom	6	3
TOTAL	39	22

European navies' logistic support vessels in service as of end-2018.



Photo: Guy Toremans

The Italian replenishment tanker (AORH) ITS ETNA

construction programmes or consider the acquisition of a second-hand vessel from one of these EU navies. The latter option may be a more likely option due to the limited available budget. Such a vessel could then be procured by 2021. However, if the Portuguese Navy opts for a new construction, the programme may not start prior to 2027. Potential shipyards to bid for such a new platform could include DCNS, STX France, Navantia, Fincantieri, thyssenkrupp Marine Systems (TKMS), Hyundai Heavy Industries (HHI), Daewoo Shipbuilding & Marine Engineering (DSME) and BMT Defence Services.

Sweden

The Royal Swedish Navy (RSwN) has a requirement for a large auxiliary ship to provide not only replenishment, but also repair, maintenance and medical support to the fleet and, additionally, be suitable for use as a command platform. Indications are that the navy is looking into a support ship with a length between 145–160 m and a displacement

in the 13,000–15,000 tonnes range and possibly based on the Danish Navy's ABSALON class (L10 type) design. With the priority of the A26 class submarines and new frigates, the RSwN decided to continue operating its two 1980-vintage support ships, the 3658-tonne supply ship HSwMS CARLSKRONA and the 2,174-tonne support ship HSwMS TROSSO until 2025. The RSwN may start the design phase in 2019 in order to have a construction contract ready in 2021 for commissioning by 2025.

Turkey

On 24 November 2014, the Turkish Naval Force signed a contract with Selah Marine Shipyard for the construction of two new 3,800-tonne logistic support ships to supplement the TCG Akar, TCG Yarbay Kudret Güngör and TCG Binbasi Sadettin Gürcan fleet support ships which entered the fleet in 1987, 1995 and 1970, respectively. The lead ship TCG YÜZBASİ GÜNGÖR DURMUS entered service in 2017 while the second unit, TCG ÜSTEĞGEM ARIF EKMEKÇİ, is scheduled to commission in 2019.

Turkey is also pushing ahead with the development of a new 22,000-tonne multirole combat support ship – the Denizde İkmal Muharebe Destek Gemisi (DIMDEG) project, designed by STM Shipyard. At 190 metres, the new vessel will feature one alongside replenishment-at-sea (RAS) on each side, a cargo capacity of 14,000 tonnes of fuels; 2,000 tonnes of water; 1,000 tonnes of lube oil as well as 400 tonnes of ammunition and stores. In October 2018, the Turkish Under-Secretariat for Defence Industries (SSM) awarded the construction contract to Sefine Shipyard. Entry into service of the first of class is anticipated in 2020 and the construction of the second vessel could follow in the mid-2020s.

Photo: Guy Toremans



The Danish combat support ship (AGFI/AKRIA/H) HDMS ESBERN SNARE



Photo: Guy Toremans

ITS STROMBOLI, one of the Italian Navy's two STROMBOLI class replenishment tankers (AORH)

UK

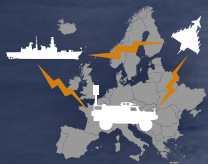
The UK's 2010 Strategic Defence & Security Review (SDSR) outlined the Royal Fleet Auxiliary's (RFA) requirement to maintain a fleet of support ships scaled to operate out-of-area for prolonged periods of time through the two Military Afloat Reach and Sustainability (MARS) programmes, namely the MARS Tanker Project and the MARS Future Solid Support Project. The MARS Tanker project comprises the construction of four 37,000-tonne TIDE class units, based on the BMT's AEGIR-26 design and constructed by DSME – partnered with BMT Defence Services – at the Okpo Shipyard, South Korea. The tankers feature three abeam replenishment-

at-sea (RAS) stations for diesel and aviation fuel and fresh water, one solid RAS station and a reel for stern replenishments. The flight deck and hangar can operate MERLIN or CH-47 CHINOOK helicopters. The lead ship, RFA TIDESPRING, was delivered in January 2017 and arrived in the UK on 3 April 2017. RFA TIDERACE and RFA TIDESURGE arrived in the UK in March 2018 and RFA TIDEFORCE in August 2018. Upon their arrival in the UK, each ship goes to the A&P Shipyard in Falmouth to complete the RFA Customisation Package.

The second phase of the RFA's recapitalisation comes in the shape of the three-ship MARS Future Solid Support (FSS) programme. These units, with a length

Conclusion

Due to strained defence budgets, navies try to put significant tonnages of a wide range of supplies into their new fleet replenishment ships in order to improve their operational capabilities and be able to undertake a multitude of support roles. An extreme example of such a platform is the Norwegian Navy's HNoMS MAUD. Obviously, for small- and medium-sized navies, such multirole support ships are an appealing solution to reduce costs. However, it is not only challenging to cram so much capability into one platform, but bringing into service support ships featuring new capabilities also requires new training and maintenance procedures. ■



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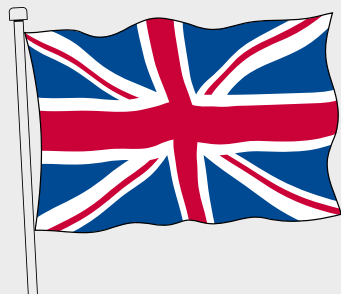
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SEA supplies a range of Maritime Combat Systems equipment, including Torpedo and Decoy launchers, Weapons Handling Systems, communications and Sonar sensor systems plus the required mission system support capabilities. SEA's Torpedo Launcher System provides the rapid launch of a range of weapon types, available in multiple launcher configurations to suit differing platforms and is designed to meet all requirements from Coastal Patrol Vessels to Aircraft Carriers. Our Sonar Systems products have applications in Anti-Submarine Warfare, mine warfare and maritime security. KRAITAR-RAY™, the low profile miniaturised acoustic array, is suitable for deployment from unmanned assets and smaller platforms.



A SEA fornece uma gama de equipamentos de Sistema de Combate Marítimo, incluindo os lançadores de Torpedo e Decoy, Sistemas de Manuseio de Armas, sistemas de sensores de comunicação e Sonar, além dos recursos necessários para o suporte ao sistema da missão. O Sistema de Lançador de Torpedo da SEA fornece rápido lançamento de uma variedade de tipos de armas, disponíveis em múltiplas configurações de lançadores para atender plataformas diferentes e é projetado para atender aos requisitos desde Navios da Patrulha Costeira a porta-aviões. Nossos produtos de Sistema de Sonar têm aplicação em batalhas submarinas, no uso de explosivos em minas e na segurança marítima. O KraitArray™, o discreto arranjo acústico miniaturizado, é adequado para a implantação de bens não-tripulados e plataformas menores.

“The largest and most important procurement programme currently in place is AIR2030.”

Photo: armasuisse



**Interview with Martin Sonderegger,
Head of Switzerland's Federal Office
for Defence Procurement armasuisse**

Switzerland's military procurement is unique, in that all defence projects are subject to a parliamentary decision, and in individual cases also to a referendum. ESD spoke with Martin Sonderegger, the Swiss Armament Director and Head of the Federal Office for Defence Procurement armasuisse.

ESD: How long has armasuisse been in existence as the Federal Office for Defence Procurement? What is the structure and what are the main tasks of your organisation?

Sonderegger: The Federal Office for Defence Procurement armasuisse is the procurement organisation of the Federal Ministry of Defence, Civil Protection and Sport (Verteidigung, Bevölkerungsschutz und Sport - VBS) and, as an administrative unit, reports directly to the Head of the VBS. Its activities range from the evaluation, procurement, maintenance and liquidation of systems and materials to real estate management at the VBS and the provision of scientific and technical services. Even though we are increasingly taking on third-party contracts for other departments, the armed forces clearly remain our main client and customer.

Last year, armasuisse celebrated its 50th anniversary. armasuisse emerged from its predecessor organisations Gruppe für Rüstungsdienste (GRD) and Gruppe Rüstung (GR). The trigger for the establishment of the GRD in the sixties was the so-called MIRAGE Affair. The Military Technical Assistance Department (KTA), which was subordinate to the army, was separated from the area of responsibility of the military leadership and transferred to an independent, civilian organisation directly subordinate to the head of the department.

Today, armasuisse employs some 850 people in a wide variety of job profiles. In addition to the main locations in Bern, Thun and Emmen, armasuisse operates nine branch offices in the real estate sector throughout Switzerland. Internationally, we are present with offices in Brussels/BEL and Washington DC/USA.

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

Sonderegger: I regularly exchange views with my counterparts, especially from European countries. We also dis-

Photo: Eurofighter



Within the framework of AIR2030, the purchase of a new fighter aircraft in an as yet unnamed number of units for the Swiss Air Force is planned. Possible contenders include the Eurofighter TYPHOON, F/A-18 SUPER HORNET, GRIPEEN E and RAFALE. The picture shows a German Air Force single seat TYPHOON over Lithuania as part of NATO's Baltic air policing.



Photo: RUAG

As a strategic technology partner of the Swiss Armed Forces, RUAG makes a significant contribution to internal security. The picture shows the tank repair facility within the framework of a cooperative model in Thun.

cuss country-specific differences in defence procurement. One of the special features of defence procurement in Switzerland is certainly the more politically dominated procurement process. Parliament has a decisive influence in this process and approves all procurement programmes. Voters can also have a say in certain procurements via direct-democratic instruments such as referendums and popular initiatives. As the procurement authority, we are therefore called upon to explain transparently to politicians and the public how we work. For many states, on the other hand, the general framework of procurement law is relatively similar. At the technological level, we are confronted with comparable issues.

ESD: Do armasuisse's responsibilities include research and development for new defence materiel?

Sonderegger: armasuisse conducts research programmes with the objective of recognising and evaluating emerging technologies in time. The findings reduce armed forces planning risks. In addition, research serves the development of competences necessary to be able to expertly assess technologies in the context of procurement processes. While the development of entire systems tends to be the exception in Switzerland, development projects for the integration of system components or for system-of-systems integration are inevitable.

ESD: What are the major current and upcoming defence procurement programmes for the Swiss armed forces? Are any of these programmes executed in cooperation with other countries?

Sonderegger: The largest and most important procurement programme currently in place is AIR2030. The programme comprises the replacement of all airspace protection systems, i.e. combat aircraft, anti-aircraft defence and air surveillance systems. In the coming years, there will also be further need for renewal and regeneration, particularly in indirect fire support at short and very short distances, tactical reconnaissance and mobile communication. In the 2020s, in addition to the entire system for protecting this airspace, almost all the other main systems procured by the armed forces in the 1980s and 1990s will reach the end of their service life within a few years. In particular, this applies to artillery, the LEOPARD main battle tanks, all special

vehicles of the engineer troops and artillery still based on the M-113 infantry fighting vehicle, Type 93 reconnaissance vehicles and the entire fleet of PIRANHA wheeled infantry fighting vehicles. It remains to be seen whether these innovations could be implemented in cooperation with other states.

ESD: In 2013, the procurement of the GRIP-EN fighter aircraft was cancelled based on a respective confederative referendum. Are any of the above programmes threatened by a similar fate? As a rule, when is a defence procurement effort made subject to a national referendum?

Sonderegger: It is likely that at least the planned procurement of fighter aircraft will be subject to a public vote, either on the aircraft alone or on a package of aircraft and an extended-range ground-based air defence system.

A public vote can be brought about in two ways: by government and parliament adopting a planning decision or law relating to the procurement, or by any interest group proposing, by popular initiative, an amendment to the constitution referring to limiting or prohibiting the planned procurement.

Parliament decided in 2018 that it wants a referendum, thus the question is currently which instrument to use to bring this about – probably a planning decision. A public vote could take place in 2020 at the earliest. Even if the procurement is approved in the scope of such a referendum, it remains still possible to try to block it subsequently by a popular initiative.



Photo: EXPAL

The Swiss army has a strong demand for renewal and regeneration, particularly with respect to the indirect fire support capabilities at short and very short distances. The 81 mm mortar from EXPAL was selected as a new 81 mm standard mortar for the Swiss army in late 2018.

Photo: GDELS-Mowag



The latest generation of PIRANHA wheeled infantry fighting vehicles

ESD: In what areas can the materiel requirements of the Swiss armed forces be met by the national defence industrial base, and in what areas do you have to cooperate with foreign suppliers?

Sonderegger: Today, there are only a few states that can fully equip their armed forces supported by their national defence industrial base alone. Switzerland is not one of them. Although Swiss industry has proven top products in individual areas, we are dependent on the procurement of foreign systems and components.

ESD: In what way do the public procurement directives in Switzerland differ from those of other European countries? Does RUAG, as a state-owned defence company, enjoy a position of preference?

Sonderegger: In Switzerland, the emphasis is on the principle of economic efficiency and, as far as possible, the generation of competitive situations. The equipment to be procured must always be assessed comprehensively throughout its entire service life. In order to reduce costs, international standards are also to be applied wherever possible, and commercially available materiel is given preference. The purchasing potential can be further optimised by establishing long-term and reliable partnerships with industry. The state-owned RUAG is the most important industrial partner of the Swiss Armed Forces. It has a special position in that it generally acts as a centre of materiel competence for the Swiss Armed Forces in the procurement of complex and safety-relevant systems.

Photo: GDELS-Mowag



EAGLE V 6x6 reconnaissance vehicle, selected by the Swiss Army.

ESD: To what extent do industrial policy considerations influence the procurement of defence materiel? Are there any offset and compensation requirements for foreign suppliers?

Sonderegger: Throughout the entire procurement process, we pay attention to long-term and sustainable business relationships with industry. Already in the planning phase, a business model with a clear allocation of tasks, responsibilities, procedures and responsibilities is defined for cooperation with external industrial service providers.

At the same time, an efficient national technological and industrial base is an important component of security policy. Selected technologies and industrial capabilities, the mastery of which is central to national security, should therefore be strengthened in Switzerland. The focus is on strengthening the competitiveness of companies and research institutions with such capabilities. This is to be achieved with measures that are fundamentally compatible with the market. One example of this is offset business.

If defence materiel is procured abroad, a compensation of 100 percent of the procurement volume in Switzerland is generally required from the foreign supplier in the case of larger transactions. A distinction is made between two types of offset business: In the case of direct transactions, the services provided by Swiss companies are included and considered for the defence equipment to be procured. In indirect transactions, Swiss companies receive orders that are not directly related to the equipment items to be procured. In our view, offset business can thus open up access to cutting-edge technologies, enable expertise to be acquired, generate additional export volumes and strengthen the position of Swiss industry on international markets.

ESD: Does armasuisse support the export efforts of the Swiss defence industry?

Sonderegger: armasuisse does not actually play an active support role. Of course, we support my foreign counterparts with information and direct contacts to the national industry.

ESD: Are there any materiel, logistic or training requirements in Switzerland that are being addressed through public-private partnerships?

Sonderegger: No, there are currently no public-private partnerships in these areas.

The interview was conducted by Peter Bossdorf and Jürgen Hensel.

Will 3-D Printing Revolutionise the A&D Industry?

Bindiya Carmeline Thomas

Although we are not yet living in the futuristic world many 20th-century science-fiction writers predicted, many recent technological advances were inspired by the stuff of fantasies.

Inventions such as GPS, Bluetooth headsets, tablet computers, automatic doors, big screen displays, real-time universal translators and teleconferencing among others all owe their genesis to Star Trek. Among the technology converted from fiction into real science is the replicator from Star Trek, a device capable of replicating machine parts, clothing, foodstuffs of acceptable "nutritional value" and even alcohol. Star Trek coined the scientific term for this technology: 3-D printing. The Stockholm International Peace Research Institute (SIPRI) defines Additive Manufacturing (AM), or '3-D printing', as processes in which layers of material are deposited and bonded together by a machine, to form an object of nearly any shape. The most widely known AM machines use plastic polymers in a process similar to the functioning of a common inkjet printer, thus often referred to as '3-D printing'.

Though not quite as capable as the replicator, the potential benefits of 3-D printing in aerospace and defence include waste reduction during production, as well as increases in production speed, shape complexity, eco-friendliness, and logistical efficiency, among others.

With such high hopes for 3-D printing technology, it's no surprise then that aerospace and defence 3-D printing market is expected to reach US\$3Bn at a CAGR of over 25%, during 2018-2023, the forecast period, according to a Mordor Intelligence study.

The market is mainly driven by the growing demand for lightweight components and parts, lightweight raw materials, such as steel, titanium, and a range of plastics that are used to increase fuel efficiency and the overall performance of an aerospace component. These plastics and raw materi-



Photo: US Army

The 3-D-printed On-Demand Small Unmanned Aircraft System, or ODSUAS, is a new concept: Soldiers provide requirements to mission planning software, and the system determines the optimal configuration for an aerial vehicle. It's printed and delivered within 24 hours.

als help to shorten the supply timeline and, therefore, improve the performance of 3-D printed aircraft parts and components for manufacturing aircraft, the report added.

The Present Scenario

3-D printing might be a disruptive force today, but it is not a new technology. The concept of 3-D printing has existed since the 1980s. Charles Hull, the father of 3-D printing, invented the solid imaging process known as stereolithography, the first commercial 3-D printing technology.

Over the last decade, the technology has advanced substantially. In 2015, Raytheon announced that "the day is coming when missiles can be printed", having already created nearly every component (about 80%) of a guided weapon using additive manufacturing. The components include rocket engines, fins, parts for the guidance and control systems, and more.

The progress is part of a companywide push into additive manufacturing and 3-D printing, including projects meant to sup-

plement traditional manufacturing processes. Engineers are exploring the use of 3-D printing to lay down conductive materials for electrical circuits, create housings for the company's revolutionary gallium nitride transmitters, and fabricate fins for guided artillery shells.

Earlier this year, the US Air Force announced that it is looking into additive manufacturing to expand its hypersonic flight capabilities. Scientists with the Air Force Research Laboratory Aerospace Systems Directorate recently entered into a Cooperative Research and Development – Material Transfer Agreement with HRL Laboratories to test additively manufactured silicon oxycarbide (SiOC) materials. The geometric complexity of components that can be produced through additive manufacturing in conjunction with the refractory nature of ceramics holds enormous potential for a variety of future Air Force applications. One such possible application is hypersonic flight, which exposes materials to extreme environments, including high temperatures. The United States may be paving the way

Author

Bindiya Carmeline Thomas is a specialist defence and aerospace journalist and a regular contributor to ESD.

for 3D printing, but American allies are quickly catching up to the technology. Earlier this year, the Royal Australian Navy announced that it was adopting additive manufacturing techniques to solve problems of regular occurrence onboard the HMAS WARRAMUNGA. According to the Navy, the WARRAMUNGA recently took full advantage of the new equipment when the ship experienced an issue with a pressure sensor. Able Seaman Electronics Technician Luke Pozzi used the new equipment to design, print and fit a temporary replacement part at sea, restoring full functional-

Computer-Aided Design (CAD), 3-D printing and software development. This workshop is based around a 3-D printer, new electronic kits and various civilian software tools. On the other side of the world, the Netherlands Aerospace Centre (NLR) announced late last year that it had produced a metal compressor wheel for a microturbine using 3-D printing techniques and successfully tested the compressor wheel at speeds of up to 200,000 revolutions per minute. The NLR measured an existing compressor wheel using a 3D optical scanner and then redesigned it using special software. The

Photo: Raytheon



A cutaway model showing the printable components of a small missile.

ducing a statically loaded component for the NH-90 helicopter in late 2016, further progress has now been made in applying 3-D printing techniques to a rotating component subjected to critical loads. NLR's Metal Additive Manufacturing Technology Centre (MAMTeC) in Marknesse, the Netherlands, offers advanced 3-D scanning and printing capabilities," the statement added.

The Promise of 3-D Printing

The tactical advantages of 3-D printing are enormous. Growing at breakneck speed, 3-D printing could essentially alter how militaries around the world operate. Or as the US Army Research, Development and Engineering Command envisions it: "Additive manufacturing will allow soldiers deployed in remote outposts around the world to 'print' virtually anything they need, from food to shelter to weapons or even print new skin cells to repair burned skin."

Rapid Prototyping

The first stage of fabricating a tool is usually protracted and repetitive. Enter rapid prototyping: an ingenious method using three-dimensional CAD data to quickly fabricate a scale model of a part or assembly. Besides being significantly faster, the advantage of 3-D printing prototypes is that it allows developers to immediately conduct design reviews, find flaws in parts, make revisions, and get a product to market much faster.

In December 2017, the US Navy partnered with E&G Associates to turn explosives into custom shapes using commercial 3-D printing techniques. The idea is to allow the Navy to figure out "how to turn plastic explosives into a nylon powder that can be fed into an off-the-shelf Hewlett Packard 3-D printer to make explosives charges of varying shapes," according to a report in the Times Free Press. In 2016, the US Navy announced that it had developed a next-generation, futuristic, 3-D-printed prototype called the Divers Augmented Visual Display (DAVD) to erase

Photo: Cpl. Justin Updegraff, USMC



A Marine makes small adjustments to a 3-D printer before loading a design during a class at Marine Corps Base Camp Lejeune, NC, 2 June 2016.

ity, the statement explained. "We looked at our options and thought 'why not just print a fix' and within 24 hours we were able to print and fit the part", said Able Seaman Pozzi. "Initially we weren't sure if it would work, so it was quite a buzz when the system came up to the correct pressure." On-board tutorials for the new equipment were developed and tailored by the ship's engineers who conduct weekly workshops on

redesign was aimed at ensuring printability and weight reduction rather than any aerodynamic improvements. During the redesign process, calculations were performed to determine the stress levels due to the weight reduction under the expected operating conditions, the NLR explains on its website. "With this new 3-D-printed compressor wheel, NLR has taken a new step in the field of additive manufacturing. After pro-

PROS	CONS
Lighter, stronger parts	Low speed
Complex geometries	Does not offer economies of scale (printing large quantities of an object would be incredibly slow and expensive)
Customisation	Size constraints
Waste reduction	Materials restriction
Cost effective	Dangerous items can be printed without oversight or restriction

the problem of low visibility underwater. By adding smart glasses to the inside of the helmet, divers will be able to receive sonar images showing their location, as well as text messages and schematics of underwater objectives.

Weapons Development

In 2017, the US Army 3-D printed a grenade launcher, aptly named RAMBO. RAMBO (Rapid Additively Manufactured Ballistics Ordnance) is the culmination of six months of collaborative effort by the US Army Research, Development and Engineering Command (RDECOM), the US Army Manufacturing Technology (Man-Tech) Program and America Makes, the national accelerator for additive manufacturing and 3-D printing, the Army explained in a statement.

Every component in the M203A1 grenade launcher, except springs and fasteners, was produced using AM techniques and processes. The barrel and receiver were fabricated in aluminium using a direct metal laser sintering (DMLS) process.



Photo: WFRM

Scientists at the Wake Forest Institute for Regenerative Medicine print ear, finger bone and kidney structure scaffolds using a 3-D printer.

"The barrel and receiver took about 70 hours to print and required around five hours of post-process machining. The cost for powdered metals varies but is in the realm of US\$100 a pound. This may sound like a lot of time and expensive material costs, but given that the machine prints unmanned and there is no scrap material, the time and cost savings that can be gained through AM are staggering," the statement added.

Wearable Sensors and Clothing

Future combat uniforms will be designed for a network-centric battlefield. 3-D printed uniforms will be better suited to the harsh combat environment, comfortable and lighter than current uniforms and will be able to incorporate ballistics materials and sensors into the wearer's clothing. These wearable sensors and devices will be able to constantly monitor a soldier's vitals and wirelessly transmit information back to the base.

Researchers from India's National Institute for Interdisciplinary Science and Technology announced last year that they have developed "a lightweight, flexible and water-repellent wearable antenna which can be 3-D printed and embedded into textiles for applications in military uniforms."

According to the study, the wearable antenna is 3-D printed from a conductive silver ink and it is flexible and lightweight, and, because it is silver and not copper, it will not oxidise. The bottom electrode on the polyester fabric the antenna was embedded into was 3-D printed, as was the E-shaped patch antenna itself.

"Our goal is to make a wearable antenna which can be embedded in the jacket worn by soldiers in remote locations," said Dr. P. Mohanan of Cochin University of Science and Technology, who also worked on the study. "We can connect the antenna to different sensors such as temperature, pressure and ECG sensors, and the data can be transmitted to a remote server. The antenna can sense and communicate data in a non-intrusive manner. This way we can monitor the health of soldiers," Dr. Mohanan added.

Customised Food

Fabricating foods such as chocolates, pizzas and pasta is another mind-boggling application of 3-D printing. In 2014, US Army researchers announced that they "are investigating ways to incorporate 3-D printing technology into producing food for soldiers."

According to the US Army Natick Soldier Research, Development and Engineering Center's, or NSRDEC's, Lauren Oleksyk, a food technologist, the technology could be applied to the battlefield for meals on demand, or for food manufacturing, where food could be 3-D printed and perhaps processed further to become shelf stable. Then, these foods could be included in rations. The advantage is that the nutrient requirement can be sent to a 3-D food printer so that

meals can be printed with the right amount of vitamins and minerals to meet the individual nutritional needs of the fighter. "We have a three-year shelf-life requirement for the MRE [Meal Ready-to-Eat]," Oleksyk said. "We're interested in maybe printing food that is tailored to a soldier's nutritional needs and then applying another novel process to render it shelf stable, if needed."



Photo: David Kamm, NSRDEC

Natick food technologists are working to incorporate 3-D printing technology into foods for the warfighter.

The US Army is currently looking at ultrasonic agglomeration, which produces compact, small snack-type items. Combining 3-D printing with this process could yield a nutrient-dense, shelf-stable product. Army food technologists hope to further develop 3-D printing technologies to create nutrient-rich foods that can be consumed in a warfighter-specific environment, on or near the battlefield, according to an official statement.

In the Field of Medicine

Recent technological advances in 3D printing have had a profound impact on the healthcare sector. Militaries around the world are actively investing in regenerative medicine and 3-D bioprinting with the aim of helping injured servicemen and women. 3-D bioprinting is one tool that US Army scientists are developing in the field of regenerative medicine. It is an early discovery technology being used to address extremity injury and skin, genitourinary and facial repair by Armed Forces Institute of Regenerative Medicine, or AFIRM, investigators. So how does it work? "In translating this technology to the clinic, scientists will take healthy cells and, using a device similar to an inkjet printer, load the cartridges with two types of skin cells – fibroblasts and keratinocytes – instead of ink. Fibroblasts make up the deep layer of skin, and keratinocytes compose the top layer," according to a statement released by the US Army in 2014.

After the team completes a scan of the burn and constructs a 3-D map of the injury, the computer tells the printer where to start printing and what type of cells to use, depending on the depth of the injury and the layer being reconstructed. The bio-printer deposits each cell precisely where it needs to go, and the cells grow to become new skin.

Engines

The benefits of using additive manufacturing in building engine components vary from saving costs to reduced lead times. Several major players in the aerospace industry are already experimenting and testing 3-D printing to develop engine components.

In January this year, Finland's first 3-D-printed aircraft engine part installed on the F/A-18 HORNET fighter had its successful maiden flight.

According to Patria, the part was designed in accordance with the Military Design Organization Approval (MDOA) and was manufactured using the Inconel 625 superalloy. "For this part, the development work has been done over the last two years, with the aim of exploring the manufacturing process for 3-D-printable parts, from drawing board to practical application. Using 3-D printing to make parts enables a faster process from customer need to finished product, as well as the creation of newer, better structures. We will continue research on additive manufacturing methods, with the aim of making the new technology more efficient," says Ville Ahonen, vice president of Patria's aviation business unit.



Photo: US Army

The additive-manufactured RAMBO system includes an NSRDEC-designed standalone kit with printed adjustable buttstock, mounts, grips and other modifications.

In 2017, GE announced that it is developing the world's largest laser-powered 3-D printer that prints parts from metal powder under a new unit, GE Additive. The printer will be able to make parts that fit inside a cube with 1-metre sides. "The machine will 3-D print aviation parts suitable for making jet engine structural components and parts for single-aisle aircraft," said Mohammad Ehteshami, vice president and general manager of GE Additive. "It will also be applicable for manufacturers in the automotive, power, and oil and gas industries."

Additive machines fuse together fine layers of powdered metal with a laser beam and print three-dimensional objects directly from a computer file. With few limits on the final shape, the method gives engineers new freedoms and eliminates the need for factories filled with specialised machines or expensive tooling.

And the year before, Orbital ATK announced it had successfully tested a 3-D-printed hy-

personic engine combustor at the NASA Langley Research Center. The combustor, produced through an additive manufacturing process known as powder bed fusion (PBF), was subjected to a variety of high-temperature hypersonic flight conditions over the course of 20 days, including one of the longest-duration propulsion wind tunnel tests ever recorded for a unit of this kind. "Analysis confirms the unit met or exceeded all of the test requirements. One of the most challenging parts of the propulsion system, a scramjet combustor houses and maintains stable combustion within an extremely volatile environment. The tests were, in part, to ensure that the PBF-produced part would be robust enough to meet mission objectives," Orbital explains on its website.

Complex geometries and assemblies that once required multiple components can be simplified to a single, more cost-effective assembly. However, since the components are built one layer at a time, it is now possible to design features and integrated components that could not be easily cast or otherwise machined.

Drones

Additive manufacturing has had a significant effect on the development of unmanned systems. Among the benefits of 3-D printing drones is the freedom to create custom UAVs, upgrade and modify for specific missions, and perform better thanks to the use of new lightweight materials.

In December 2017, the US Army unveiled a 3-D-printed, on-demand aerial drone programme "that would allow for soldiers to enter mission parameters and then get a 3-D-printed aviation asset within 24 hours." Earlier in 2017, the US Army also flight-tested 3-D-printed unmanned aircraft created with a new on-demand system.

"We've created a process for converting soldier mission needs into a 3-D-printed on-demand small unmanned aircraft system,

Photo: US Army



These parts were made using additive manufacturing, which creates plastic items and other durable components by adding material, layer by layer, using 3-D printers.

or ODSUAS, as we've been calling it," explained Eric Spero, team leader and project manager.

The programme now plans to work on improving noise reduction, standoff distance, and agility, as well as increasing the 3-D-printed drone's payload capacity.

Meanwhile, BAE Systems and the University of Glasgow envisage that small Unmanned Air Vehicles (UAVs) bespoke to specific military operations, could be 'grown' in large-scale labs through chemistry, speeding up evolutionary processes and creating bespoke aircraft in weeks, rather than years.

Introduced in 2016, a radical new machine called a CHEM-PUTER could enable advanced chemical processes to grow aircraft and some of their complex electronic systems, conceivably from a molecular level upwards.

"This unique UK technology could use environmentally sustainable materials and support military operations where a multitude of small UAVs with a combination of technologies serving a specific purpose might be needed quickly. It could also be used to produce multifunctional parts for large manned aircraft," according to a BAE Systems statement.

Limitations and Challenges

While there is no doubt of the advantages additive manufacturing offers the A&D industry, the technology still has its limitations. As it stands, 3-D printing technology cannot compete with traditional manufacturing processes. AM is predominantly dependent on a handful of polymers and metal powders to print parts, and it is limited to the size that can be manufactured. Conversely, traditional mass production processes are significantly cheaper and faster, and they don't have the same size restrictions.

"In 2013, AM thermoplastics cost about US\$200 per kilogramme, while those used in injection molding cost only US\$2. Similarly, the stainless steel used in AM costs about US\$8 per square centimetre, which is more than 100 times the cost of commercial-grade stainless steel used in traditional manufacturing methods," Deloitte explains in a study ti-

tled "3-D opportunity for aerospace and defence" published in 2014.

However, this may not always be the case. As research and development in the AM field continues to mature, the cost of 3-D printing will decline as materials selection improves in the coming years. Government agencies and educational institutions from around the world are already working to evolve 3-D printing from a prototype tool into a production one.

For instance, in February 2018, Boeing announced a five-year research agreement with Switzerland-based supplier Oerlikon to

develop standard materials and processes for titanium powder bed additive manufacturing. Soon after that, Boeing announced its investment in Morf3D, a company specialising in lighter and stronger 3-D-printed parts for aerospace applications.

Despite its limitations, the inherent capability of 3-D printing to reduce weight, waste and quickly print stopgap solutions aligns perfectly with the needs of the aerospace and defence industry.

With 4-D printing already on the horizon, 3-D printing will undoubtedly make its mark in the A&D value chain. ■



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“Our team has developed a service portfolio that complements classification services for naval ships.”



Photo: DNV GL

Interview with Christian Freiherr von Oldershausen, Vice President Naval Business DNV GL Maritime

commercial ships. Consequently, the focus on safety by using classification knowledge and process not only reduces the risk of life during peacetime operations but also forms an important and integral part in delivering a combatant's capability and its operational availability.

ESD: How do you harmonise the objective to maintain a secure, reliable and mission-ready naval platform in accordance with all relevant standards and rules with the demand for fewest possible bureaucracy as well as best-possible efficiency and transparency?

von Oldershausen: The application of classification processes provides a very efficient solution to demonstrate compliance with agreed standards and rules of a naval platform. Of course, this process differs from the usually applied procedure of classification for ships in compliance with SOLAS requirements as set by IMO but the same procedures and systematics are applied. As in merchant shipping, DNV GL's Naval Technical Assurance may range from the design stage through the newbuilding phase, include the operational use until the end of life of the warship. To be able to address the specific wishes of a navy or naval administration and/or the requirements of a project the DNV GL's process of technical assurance can be adapted and tailored to these needs. By continuing to develop DNV GL's Naval Rule set we ensure that it can fit with the NSC and other current or future naval regulatory regimes.

ESD: DNV GL has a strong involvement in research and development. What are your priorities in this area?

von Oldershausen: DNV GL's maritime innovation projects focus on developing insights into future regulations, upcoming technologies, and sustainable solutions. Some of the key questions we are examining are the impact of new technologies, connectivity, the changing energy mix, and climate change on shipping and classification. Some key areas include autonomous shipping, new fuels and propulsion systems such as batteries and fuel cells. We are also developing

rules based on functional and probabilistic requirements. This will enable more efficient and “fit for purpose” ships and structures. Additionally, big data is changing the way the maritime industry works. Increased analysis capability is key to providing insight and decision-making support. Smart management of inspection information helps to assess the integrity of the structure and systems and move towards condition-based inspections. We are also working on maritime information platforms to facilitate advanced ship and fleet performance management.

ESD: What are your current customer navies and which projects are you envisioning to constitute future business opportunities for DNV GL?

von Oldershausen: We currently see an increase of naval procurement activities with many navies including our key markets Australia, the Netherlands, Germany and Norway. The substantive investment programmes in these but also other markets provide substantial opportunities for DNV GL's Naval Technical Assurance services in continuation of already existing activities.

ESD: Can you please elaborate on the specific advisory services DNV GL offers to the naval market complimentary to DNV GL's classification process?

von Oldershausen: Over the past several decades, our team of more than 250 advisory specialist engineers, project managers, data analysts and consultants have developed a service portfolio that complements classification services for naval ships. It covers a range of platform design subjects in the areas of Deployability, Survivability and Detectability, in addition to Life-Cycle Management services. For example, DNV GL has repeatedly been involved in the condition evaluation of existing naval ships, including the structural assessment of the hull and in the determination of the used and remaining fatigue life of warships.

The interview was conducted by Peter Bossdorf.

ESD: Your company has the objective to make global seafaring safer and to improve the ships' performance, energy efficiency and environmental sustainability. Civilian operators are certainly interested in best possible economic performance, thus taking advantage of DNV GL's capabilities. However, what particularities are there with regard to naval vessels, the operators of which prioritise military performance as opposed to economic efficiency?

von Oldershausen: The well-proven principles and processes of classification are increasingly seen by navies or their respective procurement organisations as robust, mature and efficient means of technical assurance and a comprehensive proof of seaworthiness for their more and more complex ships. The objective of applying naval technical assurance through the implementation of a holistic classification process is to verify and confirm compliance of the naval vessel with agreed technical standards and regulations and thus providing confidence for a safe and reliable performance of a naval platform. Even though each Navy has its own way of approaching technical assurance there is a clear tendency that regulatory regimes for naval ships are moving towards the implementation of the goal-based Naval Ship Code (NSC) or parts of it. Undoubtedly the conditions under which a combatant is required to remain safe in addition to the float, move and fight requirements of a warship and its features are beyond those of typical

Franco-German Defence Cooperation

Giulia Tilenni

Paris and Berlin have been working on pushing forward their defence cooperation, partly thanks to the launch of ambitious joint programmes. However, the domestic and European political scenario and the deep differences between Paris and Berlin could put the strengthening of the Franco-German engine at risk.

In recent years, France and Germany have repeatedly called for stronger strategic and military ties in Europe. Following the election of President Trump and the growing security threats facing the EU, European countries have become aware of the need to achieve some strategic autonomy from Washington in order to better align their defence capabilities with the specificities of the EU in terms of political agenda and objectives.

cooperation within the EU, particularly on defence issues, Paris and Berlin decided to develop bilateral capability-based programmes to increase their strategic autonomy from Washington.

The Franco-German annual summit in July 2017 (under the Elysée Treaty) was a decisive moment for cooperation between Paris and Berlin in the defence field, as the two countries agreed on their future joint



Graphic: BMVG

The Future Combat Air System

On 25 April 2018, the two companies in charge of the programme, Dassault Aviation and Airbus, signed the industrial agreement on the Future Combat Air System (FCAS), an acronym that refers to the comprehensive programme that includes the next-generation joint fighter. As Airbus was given the lead of the MALE RPAS programme, to be developed with Italy, Spain and Czech Republic, Dassault will be in charge for the Next-Generation Fighter. One day later, the French Defence Minister Parly and her German counterpart von der Leyen signed the cooperation agreement that officially kicked off the FCAS programme.

According to the High Level Common Requirement Document (HLCORD), the next generation fighter is likely to be a multi-role (such as the RAFALE) and a flexible aircraft capable of responding to the full spectrum of air-to-air and air-to-ground missions, being a relevant asset for future operational challenges. Key capabilities for future high-intensity battlefields, such as combat ability in contested airspaces and survivability, will be ensured by new technical features that are expected to exhibit at least some degree of camouflage or low observation capability. It is expected that the next fighter aircraft can be used alone or in cooperation with allied systems (interoperability) and other FCAS systems, as FCAS will take the form of a system of systems. To meet this re-



Photo: Bundeswehr/Jana Neumann

Soldiers of the Franco-German Brigade are training at Altmark Military Training Area for Enhanced Forward Presence deployment, 29 March 2017.

France and Germany decided to lead this process and called on other EU members to strengthen their defence relations by making more efficient use of unused defence instruments, including PESCO. Aware of how difficult it is to continue genuine

programmes, namely the next-generation fighter aircraft (known as the Future Combat Air System, FCAS), a joint battle tank (Euro Main Battle Tank, EMBT) and a joint indirect fire system, as well as a new sea-plane (Maritime Airborne Warfare System, MAWS). On 22 January 2019, the two countries decided to make a further step forward with the signature of the Aachen Treaty. A sort of update of the Elysée Treaty in place since 1963, the recent deal foresees a more ambitious defence cooperation.

Author

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quirement, the fighter is likely to have real-time data merging capabilities and high connectivity features.

In relation to the operational environment, the French are likely pushing for a navalised version of the new fighter, probably to minimise duplications during pro-



A landmark agreement to develop Europe's next-generation combat aircraft – sealed in Berlin by Dirk Hoke, Airbus DS CEO, and Eric Trappier, CEO of Dassault Aviation – aims for European technological leadership in the military aviation sector.

gramme development, as is the case for F-35A (CTOL), B (STOVL), and C (CATO-BAR). Conversely, the HLCORD does not mention any nuclear capability, despite the French need to identify which aerial asset would be in charge of their airborne nuclear deterrent after 2040, when the RAFALE will complete the phase-out. According to the agreed schedule, first prototypes/demonstrators of the Franco-German fighter would start trials in 2025, with first deliveries of series aircraft expected between 2035 and 2040. However, it is not possible to assess whether the joint fighter will effectively “complement and eventually replace the current generation of EUROFIGHTER and RAFALE fighter aircraft by 2035-2040” as expected. On 6 February, Defence ministers Parly and Van Der Leyen awarded Dassault and Airbus a €65 million worth architecture and concept study for the FCAS programme. On the same date, engine manufacturers Safran and MTU signed the industrial co-operation agreement to power the future combat aircraft.

The Euro Main Battle Tank

To better advance on the next joint main battle tank, KNDS, a company born from the association of the German Krauss-Maffei Wegmann (KMW) and the French NEXTER Defence Systems, developed the Euro Main Battle Tank (EMBT). A first demonstrator, which marks the first joint programme launched since the creation of KNDS, was unveiled at Eurosatory 2018. In particular, the hull, engine and chassis of a LEOPARD 2 A7 have been modified to host the automatically loaded LECLERC turret, which is operated by a crew of two rather than the usual three. According to information released by the two companies, “the EMBT is composed of proven and tested technologies and a short-term response to the operational need of the market for high-intensity battle tanks. [...] The EMBT brings together the best in the battle tank state of the art, with an exceptional growth potential (roughly 6 t) which allows integrating many evolutions”. The Main Ground Combat System programme, which is led by Germany, is expected to enter the first test phase by mid-2019 and to allow the tank to be operational in 2035. The new land capabilities will be enhanced by the Common Indirect Fire System, expected to equip the new tank, and consequently to be developed on the same timescale.

The Maritime Airborne Warfare System

Many NATO countries are faced with the need to replace obsolete fleets of maritime patrol aircraft. Some of them agreed to cooperate in the development of the Multinational Maritime Multi Mission Aircraft. Germany and France decided to continue their cooperation in this field and included the Maritime Airborne Warfare System (MAWS) in the joint defence programmes to be developed over the next few decades. As confirmed in the HLCORD signed in April 2018, Paris and Berlin have the same operational needs and the same timetable as they will have to replace their ATLANTIC 2 and ORION P3 by 2030. Although France and Germany are still working on the definition of the system architecture, they have already agreed that the programme will be based on a converted civil aircraft, as will the P-8 POSEIDON produced in the USA. The MAWS will perform reconnaissance tasks and ensure the surveillance and reconnaissance of large areas in order to improve situational awareness and contribute to ASW activities. As the two countries aim

to develop a common European maritime patrol aircraft, the choice of platform will be based on European products. Both companies have gained relevant experience with MPA/ASW solutions, namely ATL-2 for Dassault and C-235 and C-295 MPA for CASA/Airbus. During the last EuroNaval exhibition, the company presented the concept of an adapted A320neo and hoped that the platform could serve as a basis for the MAWS programme.

Obstacles to Cooperation

France and Germany consider developing a joint fighter as part of the more comprehensive efforts, carried at the national and the EU level, to gain strategic independence from foreign countries, namely the US, as far as next-generation fighters are concerned. Thus, the concept of strategic autonomy is at the core of the whole set of programmes the two countries are willing to jointly develop.

Different Ambitions and Strategic Thinking

However, a number of obstacles remain, starting from the fact that France and Germany do not share the same idea of what strategic autonomy means. According to Paris, strategic autonomy is the ability to launch and maintain autonomous military missions to protect French interests. As the 2017 French Strategic Review recalls, developing stronger and effective bilateral (Germany) and multilateral (European) military capabilities is deemed as an important step to reach the desired level of autonomy. Consequently, France has a pragmatic approach to the use of the military instrument, and considers effective military capabilities an indispensable tool to reaffirm and maintain the country's credibility at a global level. Conversely, Berlin praises a stronger strategic autonomy for the EU, but without defining or specifying what this means or which missions should be undertaken; official documents do not refer to this issue. This is not surprising, as Germany has taken a cautious defence approach in the past. In fact, Berlin prefers the use of the military in multilateral frameworks (such as the United Nations), preferably in the framework of peace missions. Per these considerations, the joint programmes which the two countries have supported so far results from industrial or economic considerations rather than a common strategic approach. This bottom-up approach could, for example, have a threefold negative impact

on the development of cooperative programmes, and in particular on the next-generation fighter. First, the lack of a common strategy could have an impact on operational requirements, as the inability to define common potential operational scenarios could lead to deviations from expected capabilities. Secondly, the fact that the two countries do not share the same view in selecting export partners could have a negative impact on export opportunities, although they are crucial for the sustainability of the programme. Thirdly, negotiations on the requirements could take as long and cause as much delay in the timetable as is often the case with Franco-German or Europe-wide programmes.

The Treaty of Aachen is expected to bring policy making improvements in these fields. In order to enhance the impact of their defence cooperation, Paris and Berlin agreed on the progressive convergence of their common foreign policy objectives and on the establishment of a common strategic culture between their armed forces. The two countries also decided to develop a joint approach to arms exports, to intensify their cooperative programmes and to promote the consolidation and competitiveness of the European defence industrial and technological base.

The Next-Generation Fighter

Franco-German joint programmes could provide a great contribution to the relaunch of the European aerospace industry, allowing it to maintain the know-how and competitiveness that have been gained so far. Both Dassault Aviation and Airbus have stated that they consider their respective expertise sufficiently developed for the implementation of the ambitious aviation projects that their countries wish to jointly advance. In fact, Dassault is the only European company capable of independently finishing a complete fighter programme from the design phase to series production. This capability has been largely demonstrated by the RAFALE programme, which has also encouraged the ambition to maintain this capacity. Working on a new-generation fighter would allow Dassault to leverage and expand its know-how to develop state-of-the-art capabilities.

As regards Airbus' German subsidiary, the core of the country's aerospace industry, work on the next generation of aircraft will help close the skills gap created by the end of the Eurofighter programme. Without a new programme, the entire German aerospace industry could suffer the loss of

highly relevant technical capabilities, a scenario that Berlin will hardly accept given the crucial role this industry plays for the German economy.

If these joint aviation programmes are successful, Dassault and Airbus are likely to have sufficient know-how to restore their

public opinion and some political parties do not always support defence initiatives (Germany) make it difficult to sell well the idea of spending a lot of money on defence programmes and not on social policy.

In addition, the two companies participating in the programme appear to be head-



A first demonstrator of the EMBT at Eurosatory 2018. The hull of a LEOPARD 2 A7 was modified to host a LECLERC turret.

competitiveness in the top segment of the international fighter jet market and thus pave the way for the establishment of a kind of European champion in the fighter jet sector.

Sources of Uncertainty

The programme to develop the next-generation fighter serves well as an example to understand the political, economic and industrial difficulties France and Germany have to face to effectively push forward joint defence programmes.

The positive impact that developing a 5th-generation fighter will have on strategic autonomy and industrial capabilities is undoubted. However, the economic and political situation of the two countries could represent a major obstacle for the development of the programme.

In contrast to older aircraft, the development of a fifth-generation fighter aircraft requires significant cross-domain efforts by the defence industry, underpinned by consistent initial expenditure, in particular on research and development, but with expected (relatively) lower MRO costs over its lifetime. Nevertheless, the current economic situation (France) and the fact that

ing and looking in different directions. In a recent interview, Dirk Hoke, CEO of Airbus DS, stressed that the company would not accept a "Franco-French" proposal for the Next-Generation Fighter and reminded Dassault that the fact of having been awarded the lead of the programme does not mean that France will lead the entire FCAS programme. In fact, the joint fighter is part of a wider programme to create a system of systems for which the work share of the participants is still under discussion. During the Euronaval exhibition, Dassault unveiled the mock-up of the fighter, which according to Defence Minister Parly will be the most important asset of the next French aircraft carrier, whose studies are about to be officially launched and whose duration is estimated at 18 months. The early model shows an aircraft with a W-shaped wing design and a tricycle-type landing gear. However, it is impossible to assess Airbus' role in the development of this mock-up.

Final Remarks

French strategy documents such as the LPM and the Revue Stratégique reaffirm that EU cooperation is crucial to achieving

strategic independence from Washington and stress that France and Germany are the two European countries that must guide these joint efforts. In fact, the envisaged Franco-German cooperation to close current air and land competence gaps could not only provide the two countries with the desired strategic autonomy, but could

become the only EU-sphere nuclear power (and this regardless of the size of French nuclear capabilities) and the only EU member to have a permanent seat in the UN Security Council – despite President Macron having declared the possibility of sharing the French seat with other EU members under a rotational basis.

their armaments above all. Speaking to *Welt am Sonntag* at the end of February, French Finance minister Le Maire has also recalled that export opportunities outside Europe will be crucial to enhance the competitiveness and effectiveness of Franco-German defence programmes, thus calling Berlin to review its position.



The Future Combat Air System (FCAS) concept comprises a system of systems to connect manned and unmanned air platforms, including a next-generation fighter aircraft, Medium-Altitude Long-Endurance Unmanned Aerial Vehicles (UAVs), the existing fleet of aircraft such as the A400M and Eurofighter, future cruise missiles, and combat drones flying in swarms.

also serve as a model/basis for future cooperation projects between EU countries or for the extension of these projects to other European partners.

About one year after the agreement on these joint defence programmes, the positions of Paris, Berlin and of the national companies involved in the programmes, especially Dassault and Airbus, look divergent, still. France has decided to raise its defence budget and to further develop its military capabilities thanks to the launch of new programmes, including the one related to the new aircraft carrier. The German Government is showing a more timid approach to defence, thus continuing to promote inclusiveness, such as with PESCO. In other words, France is working to strengthen its defence capabilities in order to increase its ability to assert its foreign policy and revive its international role, especially in the aftermath of the upcoming Brexit. Indeed, after the UK leaves the European Union, France will

Conversely, Berlin seems shifting again towards a more introspective approach to its foreign policy, with limited international ambitions compared to France. The immediate consequence of this scenario is that the two countries are split (again) on their foreign policy priorities, something which puts the implementation of the Treaty of Aachen under question. The ongoing dispute on arms selling to Saudi Arabia is indicative of existing substantial divergences between Paris and Berlin. Following the Khashoggi case and Saudi involvement in Yemen civil war, Germany decided to suspend arms selling to Saudi Arabia – a ban which will remain in place at least until the end of March. The basic idea is that human rights' protection is more important than economic interests. On the contrary, France, as well as the United Kingdom, have strongly criticised this decision, which is harming export activities of products mounting German components, Eurofighter Thypoons and

Moreover, the skirmishes between Dassault and Airbus on the projects' leadership adds a further source of complexity. Despite Paris and Berlin having decided that the two companies must work together on the SCAF programme, Dassault and Airbus remain competitors on the European marketplace, and each considers its own abilities sufficient to take the lead on the different joint programmes to be developed.

In summary, it can be said that the success of this cooperation cannot be taken for granted, despite the fact that Franco-German cooperation has progressed considerably over the last 18 months. While France is working hard to improve its military capabilities, Berlin has recently adopted a more cautious approach, partly because internal differences in the definition of defence and the way the military is deployed could jeopardise the development of joint programmes and introduce a new phase of uncertainty into European defence cooperation efforts. ■

“Europe is at a difficult crossroads”



Photo/graphic: FEINDEF

Interview with General José Conde de Arjona, Spokesperson of FEINDEF and Chief of Institutional Support of the Spanish Ministry of Defence

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General (ret.) José Conde de Arjona

ESD: FEINDEF is taking place for the first time this year. What were the main reasons behind organising this exhibition? Can you explain the concept?

General Conde: Europe is at a difficult crossroads and is committed to strengthening the European pillar for security and defence, which is well supported by Spanish society. In this situation, FEINDEF represents the intention of Spain and its industry to become a meeting place for industry, universities and military and civil administrations to pave the way for the new European defence industry based on industrial consortia, research and innovation and dual technologies.

ESD: To what extent do you expect FEINDEF to be internationally oriented, both in terms of exhibitors and visitors/delegations? Or is it the intention to showcase national capabilities in support of the Spanish armed forces?

General Conde: FEINDEF is intended to demonstrate the performance of Spanish and international industry, with around 20% to 30% of exhibitors coming from abroad. However, the main objective of FEINDEF in this first edition is to establish itself as a de-

fence and security reference and to meet the expectations of more than 150 exhibitors and almost a hundred official delegations from all over the world.

ESD: How many exhibitors do you expect, and what are the main capability segments addressed with the exhibition?

General Conde: The exhibition area was initially designed to cover 10,000 square metres and was then expanded to 14,000 square metres with 150 stands. All capability segments are presented.

ESD: Who is allowed to visit FEINDEF and what does it cost?

General Conde: As a professional security and defence fair, FEINDEF is open to members of industry, armed forces and security forces, research institutions, science and related institutions. Access is free for professionals after registration on the FEINDEF website.

ESD: We understand that the exhibition is supported by the Spanish Ministry of Defence. What exactly does this support consist of?

General Conde: The Spanish Ministry of Defence is aware of the benefits of common defence and has therefore worked closely with the organisers from the outset, helping to win the support of other ministries and making FEINDEF a national brand exhibition.

ESD: To what extent will FEINDEF be different from previous HOMSEC exhibitions?

General Conde: HOMSEC should be remembered as the first relevant event of its kind in Spain. FEINDEF was launched as an initiative of the Security and Defence sector, with the aim of strengthening the development of new European Union defence policies and as an event that will strengthen the Spanish position and thus garner institutional support.

ESD: Will FEINDEF be held regularly, for example on a biannual basis?

General Conde: FEINDEF is planned on a biennial basis; however, the raised expectations open up possibilities to establish it as Spanish Global Brand and to be developed on other domains. The future will tell.

The interview was conducted by Jürgen Hensel



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Software-Defined Radios for Indian Air Force

(ck) Rafael Advanced Defense Systems contracted Astra Rafael Comsys Private Limited (ARC) with a US\$30M purchase order for the manufacture, test-before-integration,



Photo: Rafael Advanced Defense Systems

and life cycle support management of the BNET software-defined radio system for the Indian Air Force. ARC is a joint venture between Rafael and India's Astra Microwave Products Ltd., and this order is the first contract for ARC. Rafael Advanced Defense Systems has several subsidiaries and joint ventures in India. The "Make in India" initiative has led Rafael to invest over US\$250M dollars in the country. In 2017, Rafael was contracted to supply the BNET advanced software-defined radios to the Indian Air Force (IAF). ARC will manufacture and integrate these radio systems onboard IAF aircraft, allowing for the digital exchange of tactical information. The systems will enable IAF pilots to engage the enemy beyond visual range without being detected by their on-board sensors.

Naval Group to Cooperate with ASC

(ck) In the scope of the contract to develop and build 12 attack class submarines for the Australian Sovereign Submarine Programme, Naval Group has signed a framework agreement with shipbuilder ASC, the prime contractor of the RAN's current fleet of COLLINS class submarines. The agreement sets the terms for the two companies to work together to provide supplies and services to each other in areas such as personnel development, health and safety training and services, and supply chain services. The attack class submarines will be built at the Osborne Naval Shipyard in Adelaide, which is currently undergoing a US\$500M upgrade. Naval Group Australia and ASC will establish joint working groups to manage the framework agreement and identify, develop and recommend other cooperation opportunities. Australia intends to regenerate the Royal Australian Navy with new submarines, frigates and offshore

patrol vessels. The Osborne Naval Shipyard has been home to the Air Warfare Destroyer project for more than a decade; six COLLINS class submarines for the Australian Navy have also been built and continuously maintained there.

AMS and AUTOFLUG to Cooperate

(ck) At the HAI Heli Expo in Atlanta, the company AMS and the manufacturer AUTOFLUG signed a cooperation agreement for the supply of helicopter seats. AMS, which specialises in equipping helicopters for use in emergency medical service (EMS), was commissioned to retrofit various models. The most recent order is to equip the AW-169 model in an EMS configuration using four AUTOFLUG safety seats each. The helicopter will be equipped with FLYWEIGHT seats



Photo: Autoflug

from AUTOFLUG which are characterised by light, robust and slim construction and modern design. The foldable seats and the possibility of wall mounting allow flexible and space-saving cabin solutions.

Lockheed Martin, Diehl and Saab introduced FALCON

(ck) Lockheed Martin, Diehl Defence and Saab have recently introduced FALCON, a joint short and medium-range air defence solution for current and emerging threats. The FALCON weapon system integrates Diehl's 40-kilometre range IRIS-T Infra-Red Imaging System Tail/Thrust Vector-Controlled SLM interceptor and vertical launcher, and Saab's 360-degree AESA GIRAFFE 4A radar through Lockheed Martin's flexible SKYKEEPER command and control battle manager. FALCON's open architecture allows the system to easily integrate into any air operations centre. The Diehl IRIS-T SLM is a highly manoeuvrable interceptor fired from a 360-degree vertical launcher with the ability to engage multiple targets simultaneously. Saab's GIRAFFE 4A AESA radar offers high discrimination capabilities

to detect and track both fixed and rotary-wing aircraft and drones. Lockheed Martin's SKYKEEPER command and control battle manager gives commanders situational awareness with real-time early warning of incoming threats. Bundling these elements makes the FALCON weapon system the only integrated short and medium-range missile defence system available on the market.

FLIR to Buy Endeavor Robotics

(ck) FLIR Systems has acquired Endeavor Robotics Holdings, a developer of unmanned



Photo: FLIR

ground vehicles (UGVs), from Arlington Capital Partners for US\$382M. Formerly known as iRobot Defense & Security, Endeavor has sold more than 7,000 UGVs to customers in over 55 countries. Endeavor's robots utilise advanced sensing and actuation in providing explosive ordnance disposal, reconnaissance, inspection, and hazardous materials support for troops, police, and industrial users at stand-off range. Endeavor is one of the largest UGV providers to the US Department of Defense, and a key supplier for global military and law enforcement customers.

Air Surveillance Radars for Dutch and German Customers

(ck) About a year after Raytheon and HENSOLDT concluded a cooperation agreement, the two companies are on path to provide two European customers integrated air surveillance radars that combine HENSOLDT's primary airport surveillance radar (ASR-NG) and Raytheon's Mode S monopulse secondary surveillance radar (CONDOR Mk 3). The Royal Netherlands Air Force will receive one system that will provide both advanced Air Traffic Control (ATC) and wind-farm interference mitigation at De Kooy airfield. Deutsche Flugsicherung (DFS),



Photo: Hensoldt

the German air navigation service provider, will receive three systems to replace ageing radars as part of the country's air traffic control modernisation efforts. Both companies intend to continue jointly offering ATC solutions to customers worldwide.

SDoT Diode to Receive NATO and EU SECRET Approval

(ck) In today's data driven world, large amounts of data need to be transferred in real time, which holds a number of risks. However, isolating critical networks prevents taking advantage of sharing data. This is where data diodes come into the picture; they ensure one-way data transmission in order to protect critical networks from cyber threats. This makes data diodes ideal for sharing data with highly



Photo: INFODAS

classified domains. But up until recently, data diodes used fibre optic cables for one-way connectivity which resulted in lower speeds. The SDoT Diode developed by INFODAS has overcome this shortcoming; it enables critical and classified systems to securely exchange data unidirectionally between differently classified domains. Independent tests in cooperation with the German Federal Office for Information Security (BSI) have now confirmed the very high level of security and granted the SDoT Diode approval to GERMAN, NATO and EU SECRET. With a data throughput of up to 9.1 Gbit/s, it is currently the fastest diode on the market approved for SECRET.

Naval Group Signs Australian Submarine Design Contract

(ck) With the signing of the Submarine Design Contract Naval Group has achieved an-

other milestone in Australia's Future Submarine Programme. The contract was signed by Christopher Pyne MP, Minister for Defence and Naval Group representatives at a ceremony in Canberra. This phase of work includes the maturation of the ATTACK class design as it progresses into the next design phase known as the definition phase. This will include the selection of over 100 critical equipment items and main equipment. The Submarine Design Contract also includes preparations for the build of the ATTACK class in the Osborne shipyard in Australia, in-



Photo: Naval Group

cluding ongoing support to Australian Naval Infrastructure (ANI) for the design and build of the submarine construction yard. The first phase of the Submarine Design Contract covers a volume of A\$605M and will extend through to 2021.



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Naval Group to Establish Research Centre in Australia

(ck) As part of the billion-dollar contract to build 12 ATTACK Class submarines for Australia, Naval Group, in collaboration with 14 partners from industry, the university sector, research and development (R&D) institutes and the government, has committed itself to creating a naval research platform in Australia, to be known as the OzCean Technocampus. Naval Group experts involved in the OzCean Technocampus will conduct non-destructive testing, materials studies including corrosion and antifouling, computing and simulations. They will also be involved in the training and education programmes required to support the development of the Australian naval industry from vocational to higher education. Naval Group will also use the OzCean Technocampus to transfer, develop, and maintain R&D related products to benefit multiple sectors, including the maritime sector, oil and gas, energy, health monitoring, autopi-



Photo: Naval Group

lots and dynamic positioning, ship stabilisation, unmanned systems technologies, and maritime security.

Theon Sensors to Open Subsidiary in Germany

(ck) In response to strong demand for night vision and thermal imaging systems in Germany and neighbouring countries, Theon Sensors, a manufacturer of electro-optical night vision systems for military and law enforcement applications and one of the world's leading night vision and thermal imaging companies, has opened a subsidiary in Germany. Located in Kempen near Düsseldorf, Theon Deutschland GmbH has been founded with the aim of supporting and expanding future business. Just recently, the German Special Forces Command (KSK) has placed a major order for night vision goggles with Theon Sensors.

NOSKE-KAESER Celebrates 140 Years Anniversary

(ck) The traditional Hamburg company NOSKE-KAESER Maritime Solutions is 140 years old. In 1879, engineer Robert Ferdinand Noske founded his metal workshop in Hamburg-Altona for the construction of ventilation and heating systems. In the first few years, Noske made a name for himself with

many innovations and patents as well as specialisation in marine systems: Initial successes and prestigious orders, such as equipping the German Navy's MARS carrier in 1880, consolidated the company's reputation as a reliable partner in shipbuilding. In 1914, the second



Photo: NOSKE-KAESER

founder established his locksmith's shop. In 1947, Anton Kaeser presented his first air conditioning system. After the takeover by Blohm + Voss AG, the two companies merged in 1979 to form NOSKE-KAESER GmbH, a leading air-conditioning technology company until this very day. Headquartered in Hamburg, NOSKE-KAESER still produces tailor-made air-conditioning, ventilation, CBRN protection, refrigeration, fire-fighting and piping systems on a 7,000-square-metre site that are now installed on civil and military ships worldwide. The company employs 235 people and has additional locations in Australia, India, Malaysia, New Zealand and Turkey.

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