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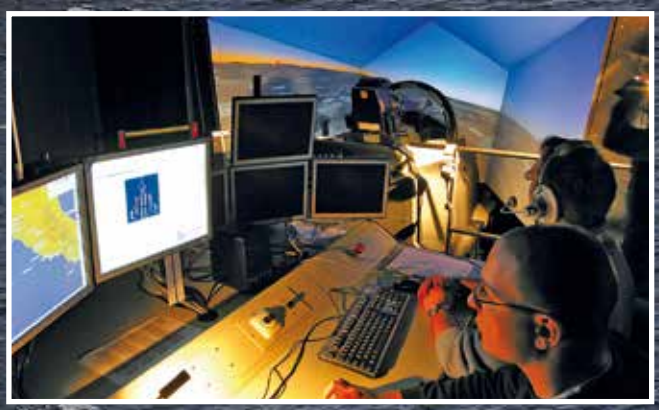

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Politics · Armed Forces · Procurement · Technology

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Out of Balance

A year ago the Defence Ministers of the European Union came together, with a enchanted-looking Federica Mogherini in their midst, for the inevitable "family photo" of a recently ended Brussels meeting. What the High Representative of the European Union for Foreign Affairs and Security Policy was thrusting towards the camera, like a chalice at the mass, was the document which was supposed to lend the gathering the gloss of a breakthrough of almost historic proportions. And indeed, this time the ministers had not just reached a general agreement about intensifying cooperation in defence policy, but had entered into some amazingly specific and attestable obligations.

There was much speculation as to why, a full three years after the NATO Wales Summit, the EU suddenly decided to play catch up, and concern itself with the option of a Permanent Structured Co-operation (PESCO) in the field of defence policy, something which had long been a possibility under the EU agreements. The simplest explanation was that the Europeans must take account of the transatlantic alienation which is associated with the name of Donald Trump, and must gradually start to stand on their own feet. Ironically, they would thereby bring to an end precisely the free-ride relationship which the Americans had blamed not just since the most recent handover of power in the White House. Other views offered the subtle interpretation that Germany had tried to draw back from the pressure being applied by France for them to appear jointly as the driving force behind European defence policy, in as much as what Paris wanted to push bilaterally would now as an endeavour of all EU members (except Denmark, Malta,and the UK) come to nothing. But the real reason may in the end have been something much more trivial: After all the crises and internal squabbles which have bothered the European Union for many years, it wanted to find a political arena in which it could eventually once again demonstrate unity and gain public consent.

What prospects of success PESCO may have cannot as yet be assessed. The hope that the EU, unlike comparable defence policy efforts in the past, can this time really get something going, is still alive, and indeed it is not even unfounded, because this time the thorny issue of financing is no longer being swept under the carpet. Nevertheless, lessons learned already today include that a psychological effect failed to appear. PESCO has neither strengthened the internal cohesion of the EU, nor enhanced its public image. It would be naïve to believe that pushing defence policy to the fore could make the ongoing crises of the community simply go away, in key areas such as finances, currency, and migration.

PESCO has, however, already brought one insight. With the departure of the UK, precisely that leading power is withdrawing from the EU which has always warned against too much centralisation and communitisation. The opponents whom London encountered in this context now see a ray of hope. The risk that the EU could fall prey to the temptation of setting up parallel structures to NATO is not to be rejected out of hand, even if a way now seems to have been found which would allow for the participation of the UK and even of the USA in PESCO projects. Neo-Gaullist tendencies to regard Europe as a security policy activist independent of the Americans, and possibly even in conflict with them, are alive and well across all political camps, and they have Donald Trump to thank for that new lease of life.

But it is not Brexit alone which threatens to bring Europe out of balance. Over the past few years the European Union has been forcing the pace on its sneaky transformation from a federation of states to a federal state, without being legitimated to do so. This can be ascribed not only to the inherent dynamics of the mammoth bureaucracy of the EU Commission. National governments have often enough pursued aims by taking a detour over Europe, simply because they could find no majority at home. On the other hand, they also repeatedly tried to declare problems, for which they themselves could find no solution, to European issues to be dealt with in Brussels. The EU has no future if it tries to disempower the Member States, or constantly act as their scapegoat or whipping boy. The next Commission, which has to be appointed in 2019, will have to focus on its core tasks and the frequently invoked subsidiarity principle, if it is to put a stop to the centrifugal tendencies, and not to set at risk the European project as a whole.

Peter Bossdorf

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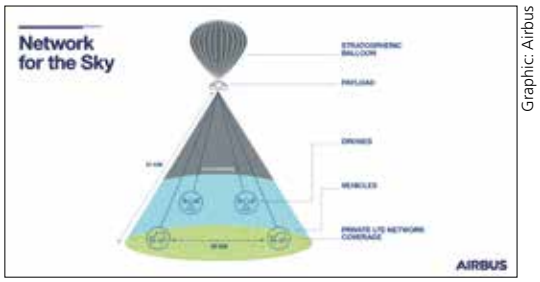
Stratospheric 4G/5G Defence Communications

(df) Airbus announced it has successfully tested stratospheric 4G/5G defence applications with a high-altitude balloon demonstration. "The technology tested, an Airbus LTE AirNode, represents a key part



Graphic: Airbus

of Airbus' secure networked airborne military communications project, Network for the Sky (NFTS)," the company said. "With this new generation of long-range communications in the sky, high-altitude platforms such as Airbus' ZEPHYR will be able to create persistent, secured communication cells to relay information on a variety of different aircraft platforms including helicopters, tactical UAVs and MALE UAVs (Medium Altitude Long Endurance Unmanned Aerial Vehicles)." Airbus NFTS solution was first unveiled at Farnborough International Airshow 2018. This system combines different communication technologies to form one resilient global mesh network, allowing aircraft to be a fully integrated part of a high-speed connected battle space. "Today, individual aircraft, UAVs and helicopters continue to operate on separate networks with limited bandwidth and interoperability, and often little resilience," Airbus stated. "NFTS will integrate various technologies, such as satellite links with geostationary, medium and low Earth orbit constellations, tactical air-to-ground, ground-to-air and air-to-air links, voice links, 5G mobile communication cells and laser connections, into a single global secure network. Network for the Sky is the foundation for the connected airborne battlespace, with the objective to offer full operational capability by 2020. The NFTS programme is part of Airbus' Future Air Power project and is fully aligned with the development of the European Future Combat Air System (FCAS)." At this test Airbus flew and tested – with the support of French and Canadian space agencies – the communications solution in Canada at all altitudes up to 21 km above the Earth's surface, using a stratospheric balloon to create a high-altitude airborne cell site. In its payload, the balloon carried an Airbus LTE AirNode, which provided a 30 km-wide footprint of coverage.

Spain Chooses Bittium

(df) Spain has chosen Bittium to supply tactical Bittium Tough SDR Vehicular radios together with the ESSOR High Data Rate Waveform (ESSOR HDR WF) for the pilot phase of the Spanish Army's VCR 8x8 vehicle programme. These radios can flexibly use the best performing waveform considering the conditions and the mission, such as the Bittium TAC WIN Waveform, ESSOR HDR Waveform and Bittium Narrowband Waveform. In the scope of the VCR 8x8 programme the Spanish Army will acquire new combat vehicles and related data transfer systems to replace their current, long-lived combat vehicles. The Bittium Tough SDR Vehicular radios will be delivered to the temporary joint venture UTE 8x8 (Unión Temporal de Empresas) formed by the Spanish companies GDELS Santa Bárbara Sistemas, Indra and SAPA. After the pilot phase, the programme will continue with another phase, during which a separate procurement deci-

Photo: Bittium

sion will be made for the supply of vehicular radios to the combat vehicles that will be deployed by the Spanish Army. Participation in the pilot phase of the programme does not automatically guarantee participation in the following phase of the programme, but it will be most likely that if the technology is tested successfully, it will be subject to procurement later.

New BLACK HORNET Reconnaissance System

(df) At AUSA, FLIR Systems unveiled its new FLIR BLACK HORNET Vehicle Reconnaissance System (VRS) with the BLACK HORNET 3 nano-unmanned aircraft (UAV), developed for worldwide military, government and first responder vehicle operations. The BLACK HORNET VRS is based on an adaptation of the unique BLACK HORNET Personal Reconnaissance System (PRS), a small battle-tested nano-unmanned airborne system (UAS). With its capabilities, BLACK HORNET VRS enables the fighter to maintain situational awareness, threat detection and monitoring for combat damage assessment, pre-deployment deployment, route and point exploration and targeted

Photo: FLIR

information targeting without the fighter having to leave a vehicle. The BLACK HORNET combines with the VRS to create a real-time air system with situational awareness (RSTA) for fighters protected in a vehicle. The BLACK HORNET VRS includes a launch unit that accommodates multiple BLACK HORNET 3 UAVs and can be mounted on the outside of any military vehicle, including armoured personnel carriers, infantry combat vehicles and light commercial vehicles. Operators in one vehicle can launch and fly the BLACK HORNET 3 on their mission using an integrated combat management system or a single display.

Poland Orders Four PATRIOT Fire Units

(df) The US Department of Defense announced that the US Army has awarded Raytheon a contract in excess of $1.5bn for production of Poland's PATRIOT Integrated Air and Missile Defense System including spare parts, support and training. The contract includes building and delivery of four PATRIOT fire units for Poland. This contract is for Phase I of WISLA, Poland's two-phase medium-range integrated air and missile

Photo: Raytheon

defence procurement. Under Phase II, Poland has the potential to acquire additional PATRIOT fire units and has expressed interest in gallium nitride-based 360-degree active electronically scanning array radars, and SKYCEPTOR, a low-cost interceptor missile, the company said. "PATRIOT will enhance Polish, European and NATO security while creating jobs in Poland and the US," said Tom Laliberty, Vice President of Integrated Air and Missile Defense at Raytheon's Integrated Defense Systems business.

Spain Orders Additional 23 NH90s

(gwh) The Spanish Ministry of Defence will approve the procurement of further 23 NH90s, an official statement said. The fleet of NH90 transport helicopters in Spain will

Photo: Airbus Helicopters

thus grow to the originally planned number of 45 aircraft. To date, the Spanish Army has eight NH90 TTHs. The decision of the Spanish Council of Ministers concerns a further six projects over a period from 2019 to 2031, including two BAM (Buque de Acción Marítima) patrol vessels, the performance upgrade of the CH-47D CHINOOK, fire-fighting aircraft, 8x8 technology programmes and an F-100 frigate.

2nd Batch VT4 Tactical Multipurpose Vehicle

(gwh) The French procurement authority Direction générale de l'armement (DGA) has ordered a second batch of 1,200 light tactical multipurpose vehicles (Véhicules Légers Tactiques Polyvalents, VLTP) designated VT4 (Vehicule Tactique) from Arquus. The vehicles are unprotected. The first batch of 1,000 vehicles was ordered with the first to be delivered this year. The total requirement is for 4,380 vehicles. The VT4 is manufactured by ACMAT, an Arquus subsidiary, on the basis of the known 4x4 Ford EVEREST 2.2 l. The militarisation of this vehicle includes, among other things, improvements in off-road mobility, preequipment for the integra-

Photo: Armee de Terre

tion of radio devices/information systems and the fitting of weapon mounts. In addition, the vehicle is equipped with several safety systems and comfort features to protect the soldiers and allow them to fulfil their duty when leaving the vehicle. The VT4 thus corresponds to the latest generation of civilian vehicles VT4 is designed for a payload of 900 kg and can transport five (or four) soldiers equipped with the FELIN soldier system.

Unmanned DAGGER 4x4

(gwh) At the MEDEF summer seminar Arquus presented the DAGGER protected 4x4 vehicle in a remote controlled version. With the technology demonstrator Arquus shows how production vehicles can be equipped for unmanned operations, e.g. in endangered areas. Arquus started its 2017 robotisation programme with the DAGGER UGV. The DAGGER is

Photo: Arquus

the export version of Panhard Defense's Petit Véhicule Protégé (PVP), which has been introduced in large quantities by the French Army. The UGV prototype is currently operated with manual control, but the ultimate goal is to develop a fully autonomous vehicle.

Fourth Batch of KC-46a Tankers Ordered

(gwh) The US Air Force has ordered a fourth batch of 18 KC-46A tankers for

Photo: Boeing

$2.9bn from Boeing. The contract modification provides for the exercise of an option for an additional quantity of 18 KC-46 aircraft, data, two spare engines, five wing refueling pod kits, initial spares, and support equipment being produced under the basic contract. In 2011, Boeing won the development and supply contract in competition with Airbus. The maiden flight took place three years later. The first production aircraft flew for the first time at the end of 2017. Acceptance tests are currently underway at the US Air Force.

BORSUK IFV With Rubber Band Track

(gwh) The established Polish system house Huta Stalowa Wloa (HSW) is developing

Photo: HSW

an infantry combat vehicle under the name BORSUK, which was presented as a prototype at MSPO in Kielce. For this new vehicle numerous components have already been pre-selected. These include an MTU 600 kW engine, the ZSSW-30 remote-controlled turret with a 30 mm cannon, and the Soucy Composite Rubber Track (CRT). Soucy's CRT system consists of a continuously sheathed rubber band structure reinforced with a range of composite materials and steel cord, which is up to 50 percent lighter than comparable steel chains. It also reduces vibration by up to 70 percent and noise by up to 13 dB. The BORSUK IFV is an amphibious and quite fast, agile vehicle.

100th TRAKKER GTF 8x8 Delivered

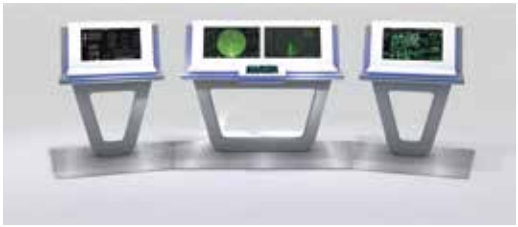
(gwh) Iveco Defence Vehicles, a subsidiary of CNH-Industrial, has delivered the 100th TRAKKER GTF 8x8 to the Bundeswehr. The vehicle is part of a supply contract for a total of 133TRAKKER GTF 8x8, which was concluded in 2015 covering a term of four years. The protected transport vehicles (GTF) of the Bundeswehr are equipped with a cabin which protects the crew against the effects of fire and mines (IED). The TRAKKER combines a high degree of mobility with an outstanding level of protection. The cabin hardly differs in appearance from an unprotected one. The TRAKKER GTF 8x8 is designed for a military payload of 15 tons. With five different configurations – some with hydraulic crane and winch systems – different ISO containers can be transported.

Photo: Iveco

The remaining 33 vehicles will be delivered to the Bundeswehr in accordance with the planned delivery schedule.

Integrated Bridge System

(gwh) At SMM MTU presented the concept for a new integrated bridge system. This system provides access to all relevant ship information required for the safe and efficient operation of the ship. This includes the MTU propulsion system, the MTU automation system, the power management system as well as navigation, radar and communication. This allows the entire ship to be monitored in its operational sequences. All information is displayed uniformly and clearly on a central display. MTU offers the integrated bridge system for yachts, merchant vessels and military vessels with MTU propulsion systems. In MTU's integrated bridge system, individual subsystems such as propulsion systems, ship automation and navigation are fully integrated into a central bridge system. The central availability of all data allows information from various subsystems to be combined, stored, analysed and displayed on networked screens of the automation system. The bundled information forms the basis for increasing availability, reducing life cycle costs and improving operational safety through further evaluation.



Graphic: MTU

Naval Radar NX

(gwh) At Euronaval in Paris, Raytheon Anschütz presented the new SYNAPSIS Naval Radar NX navigation radar software for the first time. The state-of-the-art software is based on an IMO radar display with optimised tracking characteristics and anti-clutter processing and is also equipped with tactical functions. In addition, there is the video merging function, which integrates the video of several radar transceivers into a single, high-quality radar video. The modular software design offers a high degree of flexibility for future upgrades to adapt to the respective mission requirements. To support specific naval requirements, Raytheon Anschütz has implemented tactical functions such as helicopter tracking, formation management, alarm and watch zones, and tactical target management in the radar software, giving it the new capabilities. This makes Naval Radar NX an effective and unique application for safe navigation and tactical tasks that can be performed within a single user interface.

Photo: Raytheon Anschütz

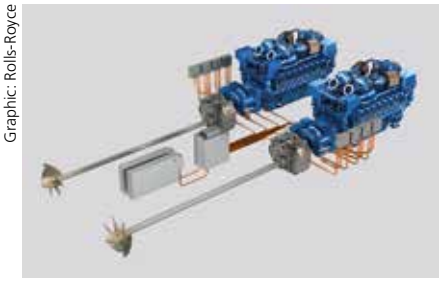
BOXER SKYRANGER for Air Defence

(gwh) Rheinmetall has integrated a SKYRANGER Mk 4 turret equipped with a 35 mm Oerlikon revolver gun with the BOXER 8x8 armoured vehicle. With an ammunition stock of 252 rounds, targets up to 4,000 m away can be engaged with a cadence of 1,000 rounds/minute. The BOXER can follow the combat troops in surveillance missions. With X-band or Ku-band radar, the airspace can be monitored and targets can be tracked while on the move. Targets can also be assigned by external search radars or higher command levels. The vehicle must stop for firing. The cannon is equipped with two measuring coils and one programming coil to fire AHEAD ammunition. This makes it possible to measure the current rate of muzzle velocity (v0) of the ammunition and set the exact detonation time depending on the measured target distance. At the target, the projectile ejects 152 or 600 projectiles to destroy targets like, for example, UAV. During a demonstration of the system in cooperation with industrial partners in the presence of air defence experts at the Ochsenboden proving ground (Switzerland), two UAVs were located, tracked and successfully destroyed by the system. The BOXER SKYRANGER can enter series production in the foreseeable future and could, for example, cover the need for mobile air defence that the Bundeswehr needs in order to participate in the NATO VJTF.

Photo: Gerhard Heiming

Hybrid Propulsion Systems for Ships

(gwh) Starting in 2020, Rolls-Royce will launch various fully integrated MTU hybrid marine propulsion systems. The propulsion systems will be offered for yachts, workboats, ferries and patrol boats in a power range from approximately 1,000 kilowatts to 4,000 kilowatts per driveline. Rolls-Royce plans to test a new MTU hybrid system with Series 2000 engines in 2019. Rolls-Royce will offer complete MTU hybrid propulsion systems for ships, including MTU internal combustion engines, electric propulsion modules, transmissions, batteries, control and monitoring systems and other electronic components. The systems will be offered in different power ranges depending on requirements. From 2020, systems with MTU Series 2000 engines will be available on the market with one to two electric motors per driveline, each with 150 kilowatts, covering a power range between about 1,000 and 2,200 kilowatts per driveline. Starting in 2021, MTU will expand its portfolio with hybrid systems the power of which is based on MTU Series 4000 engines and up to four electric motors, each with 150 kilowatts of power, and which enable a power range between about 1,000 and 4,000 kilowatts per drive train.



Graphic: Rolls-Royce

More than 100,000 Flight Hours for H225M

(ck) The H225M, with 88 aircraft currently in service in France, Brazil, Mexico, Malaysia, Indonesia, and Thailand, has surpassed the 100,000 flight hour milestone, following its first delivery to the French Air Force in 2006. The aircraft was rapidly deployed by the French Air Force in Lebanon in 2006 where

Photo: Airbus

the H225M, also known as the CARACAL, evacuated around 300 people. Since then the 11-metric-tonne H225M has been in service in crisis areas such as Afghanistan, Chad, the Ivory Coast, the Central African Republic, and Mali, while also supporting NATO-led operations in Libya. Operating both from ships and from land, this helicopter has an all-weather capability supported by night vision goggle compatibility. The helicopter's 1,300 km range can be extended with air-to-air refuelling capabilities, allowing for flight times of up to 10 hours. The Royal Thai Air Force has recently ordered four more aircraft for combat search and rescue and troop transport missions. Other recent customers for the H225M include Kuwait and Singapore.

First VT4 Vehicles in Service

(ck) On 11 October 2018, the 12th French Régiment de Cuirassiers received the first two VT4 vehicles during a ceremony organised in Satory at SIMMT, the army structure responsible for the maintenance of all land

Photo: ARQUUS

equipment. The ceremony took place in the presence of Major General Charles Beaudouin, Deputy Chief of Staff of the Armed Forces, who was in charge of the VT4 programme. The VT4 programme is based on a partnership with Ford. ARQUUS has militarised a civil 4x4 Ford vehicle by adding more than 250 new parts for mobility (suspension, brakes), ergonomics and integration of military equipment. This concept combines the safety of modern vehicles with the robustness required for military operations. ARQUUS will be responsible for maintenance and support. In December 2017, production of the VT4 started at the ARQUUS plant in Saint-Nazaire. Tier 2 of the VT4 program was signed by the DGA on 7 September 2018. It comprises an additional 1,200 vehicles with 350 modifications to be delivered in 2019.

Land-Based Payload for Border and Coastal Surveillance

(ck) CONTROP, a company specialising in electro-optics (EO) and InfraRed (IR) defence and homeland security solutions,

Photo: CONTROP

presented the MEOS-LRS, the latest member of its family of land-based automatic detection and identification surveillance systems with SWIR capabilities, at AUSA 2018. The MEOS-LRS system was developed to provide long-range surveillance capabilities for border and coastal surveillance as well as force protection. Its SWIR capabilities enable vision and observation in difficult terrain and environmental conditions, including fog, smog, dust, and at twilight times. The panoramic observation capabilities of the MEOS-LRS enable quick decision-making regarding focus areas. The system enables execution of exact target coordinates based on the GPS system. The compact, portable system may be carried on a soldier's back and is quickly and easily deployed.

New Coastal Surveillance Tool

(ck) CONTROP presented the TORNADO-ER, an Electro-Optical panoramic scanning and automatic maritime target detection system, at EuroNaval 2018. This new coastal surveillance instrument enables the simultaneous detection of a variety of targets in real-time, in all weather conditions. The system provides a 360 panoramic IR image up to the horizon of all maritime views. The

Photo: CONTROP

image is updated continuously - every 3 seconds - with automatic and simultaneous detection of any moving targets in the water. A small boat of 3x1 metres can be detected at a distance of 5 nm and more. The TORNADO-ER includes two Thermal Imaging InfraRed (IR) cameras that provide a real-time, panoramic image from short to long distances up to the horizon. The system enables the simultaneous detection of moving targets, including swimmers, vessels of all sizes, and small floating objects. These capabilities enhance the situational awareness of coastlines, waterways, seashores, ports and harbours.

Parachute for Drones

(ck) The Austrian company Drone Rescue has developed a parachute rescue system for unmanned air vehicles. The DRS-5 parachute rescue system is designed to ensure that even in a Beyond Visual Line of Sight (BVLOS) emergency the drone can be safely

Photo: Drone Rescue

intercepted. The parachute safety solution works autonomously and ejects the parachute in fractions of a second, enabling the drone to be used safely even over crowded terrain. Drone rescue products reduce the risk of harming people on the ground and safely bring down expensive equipment when there is a malfunction of drones in the air. The system is designed for multicopters with a total weight of up to 8 kg and consists of a carbon cage in which the parachute is stored, and the associated electronics monitoring the flight status of a drone independently of the air traffic controller. An algorithm mixes these sensor data to detect an impending crash, so a pilot no longer has to press an eject button in an emergency. All flight data and movements are recorded in a black box. In an emergency, these can be read out at the customer's request and made available to insurance companies or authorities. Once the final flight tests for the DRS-5 have been completed, the first systems will be delivered to customers in winter 2018.

WiSENT Engineer Vehicle for Norway

(ghw) The Norwegian procurement authority NDMA has placed an order with Flensburger Fahrzeugbau Gesellschaft mbH (FFG) worth €45M for the WiSENT 2 engineering vehicle, which is to be delivered between 2019 and 2021. Three years ago, Norway ordered six WiSENT 2

Photo: FFG

armoured recovery vehicles, which were delivered to the Norwegian armed forces ahead of schedule. WiSENT 2 is a versatile armoured support vehicle on the chassis of a LEOPARD 2 main battle tank that can be flexibly configured for various tasks - in this case recovery and engineer tanks. The WiSENT 2 engineer vehicle is highly digitised and comes with Kongsberg's Integrated Combat Solution (ICS) system already installed in Norway's WiSENT 2 armoured recovery vehicle, a powerful excavator and clearing system and FFG's new Auxiliary Power Booster (ABP) to replace the previously diesel-powered auxiliary units (APUs). As a lithium battery solution, the APB offers a genuine "silent clock", as the system operates completely noiselessly and emission-free. For self-protection, all Norwegian WiSENT 2s will be equipped with Kongsberg's remote-controlled Nordic Phase 1 weapon station.

Autonomous Dozers

(ck) Israel Aerospace Industries (IAI) was awarded the contract to convert Caterpillar dozers into autonomous dozers for high-risk tasks. This is an important contract in the field of military robotics, reflecting the challenges of the future battlefield. IAI was awarded the contract after a lengthy development process and demonstration of the

Photo: IAI

system's performance, including comprehensive testing of the maturity of the technology and its safe integration with combat systems. The new autonomous system incorporates IAI's robot technology based on the customer's operational requirements. The new autonomous bulldozer offers different degrees of autonomy including motion and earthworks for a variety of applications: Construction, path lighting in difficult terrain and the removal of large or suspicious obstacles without endangering human lives. The system is equipped with object detection and avoidance functions and is designed for use in all weather and visibility conditions.

WINDGUARD Radar for the US Army

(ck) ELTA Systems, a subsidiary of Israel Aerospace Industries (IAI), has been awarded a contract by Leonardo to provide the US Army with WINDGUARD (ELM-2133) active protection radar. The radar will be supplied as part of the Rafael TROPHY system for the ABRAMS main battle tanks to support immediate operational require-

Photo: IAI

ments. The contract has been awarded following successful performance demonstration in the Expedited Active Protection Systems (ExAPS) Programme on the M1A2 ABRAMS MBT. WINDGUARD is a combat-proven system installed on IDF MERKAVA and NAMER armoured fighting vehicles. The radar continually scans the platform's vicinity for anti-missile threats such as anti-tank rockets or guided missiles, and tank shells. Once a threat is detected and tracked by the radar, it provides an early warning to the crew and simultaneously activates the system to intercept and neutralise the threat before it hits the platform. The entire process takes a fraction of a second and is performed automatically with no human intervention.

Fire-Control Radars for Asia

(ck) ELTA Systems, a subsidiary of Israel Aerospace Industries (IAI), has been awarded a US$55M contract for the provision of multimode airborne ELM-2032 fire control radars to be installed on newly produced advanced combat aircraft. The radar offers a broad range of operational modes, including high-resolution mapping in SAR mode, detection, tracking, and imaging of aircraft, moving ground and sea targets. The contract is a repeat order, reflecting the customer's high satisfaction with the radar

Photo: IAI

and ELTA. The radar can be installed on a variety of airborne fighters. As one of the leading radars of its type, it is operational in many countries worldwide.

TAURUS Upgrades for Spain

(ck) The Spanish MoD contracted TAURUS Systems to upgrade the TAURUS KEPD 350 weapon system. The contract is worth about €30M. The TAURUS KEPD 350 missile has been in the inventory of the Spanish Air Force for 10 years and is operated on the EF-18 fighter aircraft. With its long range and an intelligent warhead, the stand-off TAURUS missile provides a strategic and tactical advantage to the Spanish armed

Photo: MBDA

forces. It is optimised for attacking deep buried bunkers, infrastructure and aerial targets in anti-access and area denied environments. As part of the contract the navigation system of the Spanish TAURUS missiles will be improved to increase the survivability beyond the original configuration. The project will start immediately.

New Order for NOSKE-KAESER for K130 Corvettes

(ck) In September 2017 the German procurement agency BAAINBw commissioned the K130 consortium to build a second batch of five K130 Class corvettes. The consortium consists of Lürssen Werft GmbH & Co. KG, ThyssenKrupp Marine Systems and German Naval Yards Kiel. Lürssen Werft, the leading company of the ARGE K130 consortium, commissioned NOSKE-KAESER Maritime

Solutions for the supply of the air conditioning, ventilation, refrigeration and fire extinguishing systems, the heating systems, the CBRN protection system and the warfare agent detection system. The order also includes installation and commissioning. NOSKE-KAESER had already successfully taken part in the first batch. Delivery of the first components is scheduled for 2019. Installation will take place at the four shipyards partnered in the consortium in Bremen, Kiel, Wolgast and Hamburg. The new corvettes will enter service from 2022 onwards.

UAS Launcher for Leonardo

(ck) Robonic Ltd, a subsidiary of Safran Electronics & Defense, has delivered a third generation KONTIO pneumatic launcher to Leonardo. This high-pressure pneumatic launcher is designed to launch unmanned air vehicles and drones and is capable of catapulting several types of drones. The KONTIO Launcher is a mobile launcher with a wide mass and speed range, making it ideal for various UAS. It is designed for take-off of aircraft up to 140 kg with an exit speed of 70 m/s or alternatively 500 kg at 37 m/s. Robonic has over three decades of operating experience in supporting the evolving needs of the global UAS industry and UAS end users.

Photo: Safran

Maritime Rescue System with Low-Interference Radar

(ds) The German Fraunhofer Institut für Hochfrequenzphysik und Radartechnik research institute cluster, the University of Applied Sciences Aachen and Raytheon Anschütz are developing a sea rescue system based on a low-interference radar in the publicly funded joint SEERAD project. For this purpose, compact and cost-effective transponders are being developed which send back a frequency-doubled radar signal which is received and evaluated by a harmonic radar system which is also to be developed. This signal is not superimposed by the otherwise typical interference caused by reflections from waves. This means that shipwrecked or small lifeboats drifting in the water can be reliably located at long distances of up to approx. 10 km, even in heavy seas. The system consists of small transponders in life jackets or life rafts/lifeboats, for example, which reflect the radar signals of future ship radars equipped with an extension module and thus indicate the exact position of shipwrecked persons in the water.

Artwork: Fraunhofer Institut

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The Impact of Brexit on EU Defence

Giulia Tilenni

The United Kingdom will officially leave the European Union on 29 March 2019. Defence is one of the issues on which the parties are struggling to reach political agreement.

Over the last two years, Member States and EU institutions have worked hard to clarify how Brexit should be implemented, focusing on post-Brexit relations between the UK and the European Union. Media attention has not been centred on future defence cooperation, but this is a sensitive issue that is still under discussion.

Photo: Claude Truong-Ngoc

Strasbourg, 28 June 2013, Place de la République. Change of leadership in the European Corps (Eurocorps), an intergovernmental military corps of approximately 1,000 soldiers stationed in Strasbourg, France

The United Kingdom and European Defence

The United Kingdom (UK) was one of the sponsors of an EU common security and defence policy agreed in 1998 with the Saint-Malo agreement signed with France. Since then, however, London has blocked the further integration of defence in the EU, believing that NATO is the only institution responsible for the defence of Europe. For example, the United Kingdom has preferred to participate in the so-called coalition of the willing or to sign bilateral agreements rather than to continue EU cooperation in the defence field. The country therefore has close political and industrial relations with a number of EU members, notably France (Lancaster House Treaty, 2010) and Germany.

Brexit could be read as an opportunity window for strengthening EU defence, as the UK cannot "veto" further cooperation any more. The fact that PESCO, considered the "sleeping beauty" of European treaties, has finally been established this year seems to demonstrate the likelihood of this scenario. However, the fact that the UK will leave the European bloc raises a number of questions on the future of European defence concerning different aspects of defence cooperation. Making a comprehensive assessment of this issue will be particularly complex due to the numerous angles (domestic and foreign politics, contribution to operations, industrial cooperation) and to muddled negotiations. Thus, in order to be as precise as possible, we will try to analyse separately the impact on the most relevant angles of European defence, and then try to draw comprehensive conclusions.

The Impact of Brexit on European Defence as Foreign Policy Tool

Together with France, Great Britain is not only the most capable European country in military terms, but also a nuclear power. Although nuclear issues are not at the core of European cooperation, Brexit means that the EU will lose one of its two representatives in the UN Security Council, with a further loss of political weight within this institution and, more generally, in international politics.

According to an official paper released in September 2017 by the British Government, Brexit will not have an impact on European defence because London and Brussels will continue to pursue strong defence cooperation. The paper identifies several reasons that should push the two parties to pursue their defence cooperation even after Brexit: shared values and threats, British contribution to European security and defence and cooperative defence projects, bilateral cooperation with European partners, and the contribution of British companies to R&D in the defence domain. However, Brussels does not want to let London continue to have the same rights it had as a member state, for at least two reasons. First, the EU Global Strategy and the growing tensions with Washington are making EU members more willing to gain some form of strategic independence. On its side, the UK has historically been strongly linked to Washington in the military domain. Thus, Brussels fears that maintaining strong defence cooperation with London could block the pathway towards stronger independence, something that the U.S. do not want to grant, as confirmed by the concerns that PESCO projects raised within their NATO

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ally. Second, Brussels is convinced that fixing strong rules for Brexit could discourage other countries from asking to leave the EU. Despite British claims, the balance of power within NATO will be reshaped after Brexit, with a declining role for the remaining 21 EU members. So far, the UK has had a pre-eminent role in NATO's structure. Conventionally, some positions, such as the deputy SACEUR, are assigned to European countries. In the last decades, Washington has secured the respect of its agenda setting by assigning these positions to Brits, as London has usually served as a bridge between Brussels and Washington – a role that London envisages maintaining in the future. After Brexit, this tradition should be updated to rebalance the representation of EU members within the Atlantic Alliance. However, due to tense relations between Brussels and Washington, it is unclear if NATO will break with this tradition, or maintain it in place, thus further reducing the role of European countries within this institution.

Photo: Iloethe

Brexit could be a window of opportunity to strengthen EU defence, as the UK cannot "veto" further cooperation anymore.

The Impact on EU-led Military Missions

According to "Brexit: Common Security and Defence Policy missions and operations", a report released in May 2018 by the House of Lords' European Union Committee, Brexit will have a heterogeneous impact on Common Security and Defence Policy (CSDP) missions. The impact will be important on the EU force catalogue (which identifies the forces and capabilities pledged by member states according to the military capabilities required by the EU), as the UK "contributes, or is shown to have, about 20%" of this catalogue. Brexit is also reported to have a financial impact on CSDP missions, as so far the UK has funded around 16% of military operations' common costs. Conversely, the impact of Brexit in terms of personnel deployment will be relatively minor. The UK contributed personnel to 25 out of the 35 EU-led operations, with a total participation of about 2.3% of total members states' contribution. Operation Atalanta's headquarters represents the only notable exception, with 56 Brits amongst the 104 staff.

Brexit and Pan-European Defence Programmes

Although Britain is not at the forefront of the EU's common defence effort, British industry has been involved in numerous cooperative pan-European projects. Contrary to what Britain claims, most of them, although developed in cooperation with EU Member States, were not part of the EU framework. These include the Eurofighter TYPHOON fighter, the MBDA METEOR air-to-air missile and other projects developed under OCCAR (an organisation that works with European institutions without being part of the EU institutional framework).
The Galileo and Kopernikus programmes are notable exceptions, as the UK and its industry have been heavily involved in the development of the programme. In recent months, EU negotiators have already outlined how they intend to redesign the UK's contribution to the Galileo programme after Brexit. More specifically, Brussels plans to block UK access to R&D and future industrial developments, but to give the UK access to the signal if agreement is reached. So far, the US and Norway have negotiated concrete agreements to secure access to the Galileo Public Regulated Service. In practice, this means that the UK will no longer participate in decision-making on joint projects or in the planning of military operations. Companies or the military will continue to be able to join the programme, but only in a second phase, so that they will not be able to evade sensitive information. In addition, the UK will lose membership of the European Defence Agency (EDA) and its participation in EDA-led projects will depend on the signature of an administrative agreement approved by the EU Council. This is already the case for Norway, Serbia and Ukraine. As for the EDA, Brexit has already had a positive impact, as EU countries have finally had the opportunity to overcome the UK's six-year resistance to the increase in funding for the agencies, which has been increased from €30.5M to €31M, +1.6% in line with inflation.

The Impact of Brexit on European Defence Industrial Cooperation and on the EU Defence Market

The United Kingdom has been heavily involved in the creation of a common EU defence market and is one of the states that is compliant with the defence package directives. Thus the impact that Brexit could have on the further development of an EU defence market is likely to be greater than that in the field of military cooperation, in which London has always had only limited involvement, particularly in relation to the UK's defence capabilities as a whole. The impact of Brexit on the EU defence market will depend heavily on how future economic relations between the EU and Britain are regulated, one of the hottest issues in the ongoing negotiations. For the time being, EU negotiators are not expected to regard defence as an exclusion from general internal market rules for third countries, irrespective of the type of defence cooperation agreement that the two parties may reach. In practice, this means that London is likely to lose its free access to the European defence market as it will be considered a third country after March 2019.

However, British defence companies and associations, notably ASD, have repeatedly called on the government to reach an agreement which would allow the UK to remain part of the EU internal market and a member of the EDA, thus enabling it to participate in European R&D programmes. In fact, it is crucial for UK companies to maintain close links with European defence companies, as there are a number of ongoing joint programmes - for example METEOR and STORM SHADOW/SCALP for missiles.

From the point of view of EU companies, the impact of Brexit will be higher in the case of a no-deal scenario. Should the UK be excluded from the EU single market, the technologies produced in the UK will be subject to customs duties, leading to supply shortages. Some companies, such as Airbus, have stated in recent months that they have spare parts in stock to prepare for the worst-case scenarios following Brexit. The nature of the negotiations that London and Brussels will conduct will also have a strong impact on the organisation of companies operating in the UK or having one of their headquarters in the country. Under the EU legal framework, a company must have the centre of its decision-making in an EU country in order to gain access to the EU market and probably to EU defence funds. This means that international companies such as MBDA (BAE Systems is 37.5% shareholder) and Airbus will be affected by Brexit in terms of organisation and labour share, but probably with limited impact on their economic activities. Conversely, the impact of Brexit will be higher for European companies for which the UK is a relevant market. Leonardo, an Italian company, is one of the companies that could be most affected by Brexit for two reasons. First, after Italy, the UK is one of the most important markets and the most important production location. Second, as announced at the Farnborough Air Show in July, the company will be responsible for establishing and integrating the Tempest programme team, which is expected to develop the next-generation British jet fighter. A few days after the announcement, Leonardo CEO Profumo stated in an interview with CNBC that "a possible no-deal with the EU would be a problem as we have a significant presence in the UK". He also added that a No-Deal Brexit could make working with UK companies more complicated, potentially affecting participation in the Tempest programme which he described as "very important to the company".

Final Remarks

Despite London's assertions, Prime Minister Theresa May's recent statement questions whether the UK will be able to remain a top military power and benefit from Brexit (according to some British politicians, EU membership has downgraded the UK's international role). The fact that London and Brussels are still looking for an agreement on the Brexit relationship, thereby increasing the likelihood of a no-deal scenario, leaves a number of defence cooperation issues open for the time being. Defence companies are working to convince the EU institutions of the benefits of close relations with the UK institutions and hope that Brexit's cooperation projects will not be seriously affected. However, as future cooperation will be top-down, Member States will have the final say on how this cooperation is to be structured. It is clear that Brexit means that only one EU country can offer a (limited) nuclear roof, France, and that the bloc will lose one of its most capable members. So if the EU really wants to improve the role of defence as a foreign policy instrument according to the EU's Global Strategy, Brussels would have to further develop cooperation to "balance" Brexit. A challenging ambition in times of tight budgets, especially in view of the heterogeneity of the military capabilities of the member states.

Viewpoint from Kiev

Instability in the Sea of Azov to Be on the EU Agenda

Alex Horobets

For a long time Ukraine had not paid enough attention to the Sea of Azov. The annexation of the Crimea and its transformation into a Russian military base was the culmination of Russian insolence. In recent months, however, Russia's activities in the Sea of Azov have moved onto the EU's agenda.

In the run-up to the European Parliament's plenary session, High Representative for Foreign Affairs and Security Policy Federica Mogherini condemned on 23 October the construction of the Kerch Strait bridge by Russia and the militarisation of the Sea of Azov. The bridge between the Russian mainland and the illegally occupied peninsula, the construction of which was never agreed with Ukraine, now hinders shipping to and from Ukrainian ports.

Photo: Kremlin

The newly-constructed Kerch Bridge connects the Taman and Kerch peninsulas in the south of the Sea of Azov.

The enormous expenditure on the bridge, which was opened in May 2018, enables Russia to control access to the Sea of Azov. Similar to the Bosporus Strait, the passage through the Strait of Kerch is not prohibited, but de facto only possible with Russian consent. Under the pretext of protecting the bridge, Russia has transferred naval forces to the city of Simferopol (Crimea), which are used for FSB inspections of ships passing through the strait. The regulations introduced for shipping under the Kerch Bridge allow Russia to control the operation of Ukrainian ports at Mariupol and Berdyansk, where freight traffic has decreased by 10-20% on average. According to available data, Ukraine loses UAH100M (almost US$3.5M) per month as a result of Russia's actions in the Sea of Azov.

Another way of exerting influence on the region is to create restricted navigation zones in the region on the pretext of military exercises. In the past, the method was used off the coast of Crimea, but today it has spread to the entire Sea of Azov. For example, the exercise of the Russian Black Sea Fleet on 24 September 2018 coincided with Ukraine's intention to establish a naval base in the Sea of Azov. In addition, the Russian FSB Coast Guard in Crimea demanded that two coastguard vessels accompany the Ukrainian naval vessels DONBAS and KORETS on their voyage from Odessa to Berdyansk.

During the Lviv Security Forum on 25 October, Vasyl Servatiuk, deputy head of the Border Guard of Ukraine, described the situation in the Sea of Azov as "serious and threatening". Currently, 120 Russian warships and boats are deployed there. Petro Tsyhikal, head of the State Border Service, reported that in addition to these ships, two patrol ships, the SYKTYVKAR and the KIZLYAR, entered the waters of the Azov Sea from Russian inland waters on 24 October.

Ukraine has become the hostage of the situation, largely due to an agreement signed in 2004 between Kiev and Moscow on the Sea of Azov which defines the Sea of Azov as inland waters for the two countries. Both states can stop ships for inspection, but at the moment the Russian side abuses this right.

NATO has reacted strongly to Russia's actions. At a press conference in Brussels on 24 October, Secretary-General Jens Stoltenberg called on Russia to comply with international law, including ensuring freedom of navigation. And the next day, the European Parliament adopted a resolution condemning Russia's violation of international law. The resolution calls on EU Member States to step up sanctions against Russia in the event of a further escalation of the conflict. One of the provisions calls for the creation of an EU Special Representative for the Crimea and Donbas, whose remit would include the Azov region. The European Parliament condemns the illegal production of oil and gas by Russia on the territory of Ukraine; Russia illegally uses Ukraine's seabed, including the right to extract energy resources in the Odessa, Holitsynsky, Archangelsky and Shrormoviy fields and the illegal construction of the bridge over the Kerch Strait. Penalties have also been imposed on the six European companies involved in the construction of the bridge.

The fact that the dispute in the Sea of Azov has reached such a high level shows that the problem does not affect Ukraine alone. After all, it is about international law; if a country is allowed to apply only the advantageous rules of international law, this may also have repercussions for other parts of the world. Norway is closely following developments in the Azov and Black Seas, because Russia and Norway are neighbours in the Arctic.

In the near future we can hardly expect any explanations from Russia. At the moment, the Russian Federation is exploiting the absence of military parity in the Sea of Azov to create an analogy to the Bosporus, where its passage is free of charge but only possible with Turkey's consent - a situation which conceals the ongoing militarisation of the Crimea the purpose of which is to maintain control over the peninsula and create a counterweight to NATO forces in the region. Crimea is also a platform for military operations in Syria and for the control of the natural resources of the Black Sea region.

Irrespective of Western support, Ukraine should resolutely address the problems in the Azov and Black Sea regions. The focus should be on the Ukrainian Navy and Air Force, which requires a joint action strategy in the region.

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Defence Lessons from Singapore

David Saw

The small and prosperous city state of Singapore affords itself a well-equipped and well-trained armed force. For decades, Singapore has been investing a considerable part of its resources in its military.

Singapore is a true city state, with a population of 5.888 million in a land area of only 709.2 square kilometres. Questions of population and land area are key to understanding the continuing evolution of Singaporean defence and security policy. Somewhat uniquely, Singapore has been able to increase its land area through a significant land reclamation effort. On independence in 1965, Singapore's land area amounted to 586 square kilometres; by 1986 the total land area had expanded to 636 square kilometres and reclamation continues.

Photo: US Air Force

A Republic of Singapore Air Force (RSAF) F-15SG at Luke AFB, Arizona, taking part in Exercise FORGING SABRE in February 2017. Singapore initially ordered 12 aircraft in 2005, adding 12 more in 2007. Subsequently, two further batches of eight aircraft each were acquired to bring the fleet size to 40 aircraft.

Maximising land usage continues to be an important issue for Singapore. One of the most important considerations for the Singapore Goverment is population. Initially they had favoured population control strategies due to being concerned about unsustainable population growth. As time went on and Singapore began to prosper, concerns over population growth were replaced by fears of population shrinkage. The population of Singapore in 1989 amounted to 2.674 million, but the population situation was characterised by low birth and death rates that were usually typical for developed economies with high per capita incomes. At the end of the 1980s, the birth rate was 17 children per 1,000 of population, with a low infant mortality rate, and with the death rate at 5 per 1,000 of population.

These population growth numbers were less than satisfactory and led the Singapore Government to encourage more childbirth. Unfortunately, the birth rate figures did not increase. By 2017 the birth rate was down to 8.6 births/1,000 of population; as a comparison the French birth rate was 12.20 births/1,000 of population. The most meaningful statistic is that the total fertility rate in Singapore amounts to 0.83 children born/woman. This is the lowest in the world! Average life expectancy in Singapore is 85.2 years; this is the third highest in the world.

An ageing population added to a low birth rate represents an immense challenge to Singapore. Put simply, an economy needs workers. Added to which, as Singapore's defence structure is based on the conscript model, it needs military-aged people and, due to the low birth rate, these will increasingly be in short supply.

As regards workers, Singapore can meet some of its needs from non-resident Malaysian workers coming across the Causeway and returning once their work is finished. It also utilises contract workers from around the ASEAN region and expatriates working in the banking and finance, education, medical and other high technology areas. There were plans to grow the population through an immigration policy, but attracting the right immigrants with desirable skills for Singapore proved harder than expected. Expanding immigration also proved unpopular with the indigenous Singaporean population and this forced the government to curtail major immigration efforts.

Economic Evolution

The Singaporean economy is in robust shape, the Gross Domestic Product (GDP) per capita, accounting for Purchasing Power Parity (PPP) ranks Singapore seventh in terms of world economies. Singapore is a prosperous nation, even by Western European

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standards. Ensuring that this prosperity continues into the future is one of the primary tasks of the Singaporean government.
One of the reasons why Singapore has developed so successfully is the fact that the People's Action Party (PAP) has been the leading political party since 1959, even prior to independence. They can take a strategic long-term view and are not swayed by the short-term thinking that many democratic governments fall victim to. It is important to note that Singapore has free and fair democratic elections. In the last election held on 11 September 2015, the PAP obtained 69.9% of the vote and therefore a majority of the seats in the national parliament. The next election is due in 2020.
To deal with the issues of an ageing population and declining workforce numbers, the Singapore Government has a strategy that will see the economy evolve along a new path. The International Monetary Fund (IMF) in its Article IV Consultation Staff Report of July 2017 is extremely positive as regards the future course of the Singapore economy.
The IMF report notes that, "Singapore has embraced a new growth model for a world of rapidly advancing digital technologies and automation. The strategy is to turn Singapore into a labour-lean economy with less reliance on foreign workers and growth based on innovation, digitisation and continuous investment in skills. Economic and social policies to make growth more inclusive and tackle population ageing have advanced appreciably in recent years and are still evolving, complementing the economic transformation drive. Singapore's track record of longer-term orientation in policy making, strong implementation capacity and proactive embrace of technical change accompanied by policies to mitigate the disruptive potential of automation on employment provide a measure of assurance about the outcome of its structural transformation."
Singapore's strategy to evolve into a "global innovation hub" brings with it a more gradual economic growth path, according to the IMF. Consequently they had projected GDP growth of 2.3% for 2017 in their Staff Report; the reality of the situation was that Singapore's growth rate in 2017 was actually 3.5%. The IMF projects a GDP growth rate of 2.5% for 2018, and economic results thus far in the first quarter of 2018 indicate that Singapore ought to achieve this figure.
Economically there is no doubt that the Singapore Government has delivered long-term economic growth. Singapore has no natural resources; its primary asset on independence in 1965 was its port facilities

Photo: Singapore MINDEF

A Singapore Armed Forces (SAF) LEOPARD 2SG tank participating in the live-fire Exercise WALLABY in Australia. Singapore acquired 96 LEOPARD 2A4 tanks from Germany under a 2006 contract. German submissions to the UN Register of Conventional Arms list the delivery of 161 LEOPARD 2 tanks to Singapore between 2007 and 2012, while Singapore declares the arrival of 156 tanks.

and the presence of a significant British Commonwealth military garrison. By the end of the 1960s, the British had started their withdrawal from 'East of Suez,'which inevitably had a negative economic impact on Singapore. What the Singapore Government was able to manage was a constant transition in economic terms, starting with low-cost manufacturing and then moving up the value chain to a high-technology services-based economy.
One side effect of this consistent record of economic growth is that it has allowed the Singapore Government to make serious investments in defence expenditure. On independence in 1965, the government was clear that Singapore would need a defence capability that could act as an effective deterrent. After all, in 1965, Singapore was a small nation, surrounded by neighbours who were not necessarily well disposed towards the new state. The government knew that it would have to establish a military capability, one that would eventually grow into the Singapore Armed Forces (SAF), and was prepared to fund such a capability to the limit of their means. It should also be noted that establishing a conscript-based military (conscription was introduced in 1967) would also establish a shared experience across all of the different ethnic communities in Singapore, developing both national identity and community cohesion. Conscription, known as National Service (NS) in Singapore, also includes an ongoing reserve commitment, up to age 40 for other ranks and 50 for officers. Apart from service in the SAF, conscription also provides personnel for the Singapore Police Force (SPF) and the Singapore Civil Defence Force (SCDF).

Defence Expenditure Trends

Many of the first generation of Singaporean national leaders had cause to remember the Japanese invasion of Malaya in 1941 and the fall of Singapore to the Japanese in 1942. At that time there was a commonly held belief that Singapore was an impregnable fortress. The reality of the situation was somewhat different, as demonstrated by the fact that the invasion of Malaya took place on 8 December 1941 and by 31 January 1942, the last British and allied forces left the Malayan mainland and retreated to Singapore. On 8 February 1942 the Japanese commenced their assault on Singapore and by 15 February the island surrendered. What followed was a brutal Japanese occupation, including the Sook Ching massacres of 1942 where an estimated 70,000 local people were murdered (some Singaporean histories put Sook Ching deaths higher at 90,000 murdered).
The invasion, the massacres and the occupation had demonstrated the fate of a small island if it was not properly prepared to de-

fend itself. The new leaders of Singapore were determined that what happened in 1941/1942 would not be allowed to happen again and that Singapore would make adequate provision to defend itself and to deter potential aggression. Singapore still has a robust and continuing commitment to an effective level of defence expenditure.
The Stockholm International Peace Research Institute (SIPRI) Military Expenditure databases provide an extended picture of the continuous investment that Singapore has made in defence. In terms of military expenditure as a percentage of GDP, between 1988 and 1999 Singapore spent an average of 4.466% of its GDP on military expenditure on an annual basis. Between 2000 and 2009 the average annual rate of military expenditure as a percentage of GDP was 4.31%. Then in the seven years between 2010 and 2016, military expenditure as a percentage of GDP was on average 3.228% per annum.
It is self-evident that this military expenditure as a percentage of GDP shows a declining trend, but another set of figures from SIPRI show that Singapore's military expenditure has generally kept to an upward trend. As Singapore's economy and GDP grew, the amount of actual money devoted to military expenditure would grow in turn. A SIPRI data set for military expenditure in constant 2015 US dollars provides a far better measure of defence expenditure. In 1988 military expenditure was US$2.9Bn; in 1989 it was US$3.2Bn even though military expenditure as a percentage of GDP was 4.5% in both of those years. By 1998 military expenditure was US$7.3Bn and in 1999 it had risen to US$7.4Bn. The fact that these figures are in constant 2015 US dollars shows the consistent growth trend. In 2000 and 2001 spending showed a slight decline (US$7.2Bn in 2000 and US$7.3Bn in 2001, then spending increased to US$7.7Bn in 2002 and US$7.8Bn in 2003, before reaching US$8Bn in 2004. The figure rose to US$8.5Bn in 2005 and then to US$8.6Bn in 2006. This year also saw military expenditure as a percentage of GDP decline to 3.9%, the lowest figure in 16 years. In 2007 spending rose to US$8.9Bn and rose again in 2008 to US$9Bn, reaching US$9.2Bn in 2009.
Between 2010 and 2016, military expenditure as a percentage of GDP in Singapore ranged from a low of 3.1% to a high of 3.4%. In comparison, the 2009 military expenditure/GDP percentage was 3.9%. This resulted in a decline in military expenditure between 2010 and 2013. In 2015 constant dollars, military expenditure in 2010 was down to US$9.1Bn; in 2011 it was down to US$8.7Bn; in 2012 it was down further to US$8.6Bn and then down to US$8.5Bn in 2013. Then came an upward trend. In 2014 military expenditure was US$9.4Bn, rising to US$10Bn in 2015 and declining slightly to US$9.9Bn in 2016.

Photo: Singapore MINDEF

RSS FORMIDABLE, lead ship of a class of six advanced frigates based on the French LAFAYETTE design; all six units were commissioned into the Republic of Singapore Navy (RSN) between 2007 and 2009. The first frigate was built by Naval Group (then DCNS) at Lorient, with the remaining five built by ST Marine in Singapore.

In an era when the majority of NATO members are struggling to meet the organisation's target of spending 2% of GDP on defence, Singapore's government has made it perfectly clear that it will continue to properly fund its Ministry of Defence (MINDEF). In early March, the Defence Minister Dr Ng Eng Hen spoke to Singapore's Parliament in a Committee of Supply Debate to discuss MINDEF spending plans in the context of the 2018 national budget. His statement contained some significant facts on ongoing defence expenditure trends in Singapore. For example, Dr Ng noted that defence expenditure accounted for 19% of government expenditure. In comparison, according to World Bank figures, Switzerland spent only 4% on defence in 2016. According to Dr Ng: "We can maintain the SAF's capabilities with a defence spending that roughly keeps pace with inflation – around 3% to 4% increase each year." It is difficult to see a European defence minister expecting a 3% to 4% increase in spending as a perfectly natural development! Furthermore, should the security environment in Singapore's region deteriorate, there is no doubting that Singapore would be prepared to significantly raise defence expenditure.
Dr Ng contrasted the Singaporean pattern of defence expenditure with that of Europe, using Germany as an example. Firstly Dr Ng referred to what were described as 'two crucial lessons' that Singapore had been able to learn: "First, the best time to prepare for trouble is during peace. Second, in the long run, steady investments into military capabilities maintains peace through deterrence and results in more effective outcomes. It is actually the most efficient yield for defence investments. In other words even if you spent the same dollar amount over a defined period, the most effective yield is continuous, steady investments."
He then went on to describe what he saw as the situation in Germany: "After 25 years of cuts to the German defence budget, the German military – the Bundeswehr – is underfunded, with entire weapons systems unusable because they either lack spare parts, or have been poorly maintained. By the German Government's own assessment, less than half of Germany's submarines and planes are operationally ready. The platforms are there, but only half can be activated."
That would be totally unacceptable in Singapore. Dr Ng gave an example of the operational readiness of SAF assets: "When the Aceh tsunami occurred (26 December 2004), we activated three of our four Landing Ship Tank (LSTs). It happened on Boxing Day, no way you could have had a prior

Photo: Singapore MINDEF

Singapore Armed Forces (SAF) infantry from the 7th Singapore Infantry Brigade (7 SIB) equipped with the locally designed and built SAR-21 5.56x45 mm rifle, take part in Exercise VALIANT MARK in August 2017 in Singapore. This is an annual bilateral exercise held with the US Marine Corps.

warning; on activation, all move, 75% of the assets of that particular platform (note: the fourth LST was on operations in the Gulf, therefore 100% of these key assets were operationally available)."

Readiness

How seriously the SAF treats operational readiness for both active and reserve forces was illustrated in January 2018, when a Mobilisation and Equipping Exercise (MOBEX) was held involving 8,000 soldiers and 700 vehicles from the 9th Division in the largest exercise of this kind since 1985. The ability to mobilise reserve forces and rapidly bring them to operational condition is a fundamental part of Singapore's defence strategy. On mobilisation, the SAF will be able to field multiple, fully equipped, division-level formations. Although Singapore might be a small country, it has the ability to activate a substantial amount of military personnel, providing an effective deterrent to aggression, both in terms of conventional and asymmetric threats.

The Singapore Government seeks to leverage innovation to further grow the Singaporean economy; it also looks to innovation to find solutions to defence issues. As previously noted, an ageing population and a declining birth rate have created a problem for the Singapore military, they have therefore looked to develop solutions. In the 1990s the Republic of Singapore Navy (RSN) acquired 12 locally built FEARLESS class 55-metre 500-ton Patrol Vessels (PVs) with a 30-man crew. The PVs will be replaced by a new class of surface units in the form of the Littoral Mission Vessel (LMV), with eight LMVs to be acquired, all of which will be built in Singapore.

The LMV is a far more sophisticated unit than the PV; these are 1,200-tonne displacement, 80-metre-long vessels, feature a comprehensive suite of weapons and sensors and offer far more operational capability than the FEARLESS PV class. One key LMV characteristic is that baseline crew number is down to 23. According to Singapore MINDEF: "The innovative design solutions to our LMVs will save us at least US$65M across the 30-year life span of the platform, when compared to the PVs." The first three LMVs are already in service with the RSN, with the second batch of three LMVs being launched at ST Marine between March 2017 and March 2018. All eight LMVs are due to be in service by 2020.

Training

The SAF can look for innovative solutions to many of the issues that it faces, but sometimes there are no easy solutions to be found. This is particularly true in the area of training; ideally it would be possible to conduct all SAF training within Singapore national territory. Unfortunately the small size of Singapore is an obstacle in this regard, it is simply impossible to conduct full-scale force-on-force combined arms training, or much live fire training, particularly for heavy weapons on national territory. The congested airspace around Singapore also presents many challenges to the Republic of Singapore Air Force (RSAF).

For many years the SAF has trained in Taiwan; live fire exercises take place in New Zealand. There are major exercises in Australia, where the SAF has access to training areas ten times the size of Singapore, and high-level combined arms exercises in the US. In March, the SAF conducted a bilateral live fire training exercise with the German Bundeswehr, Exercise Panzer Strike 2018, at the Oberlausitz Military Training Area (OMTA). Panzer Strike exercises take place in the spring and autumn in Germany, with some 1,250 SAF personnel taking part in the programme across the year using SAF equipment in the shape of 14 LEOPARD 2SG tanks and 15 BIONIX Infantry Fighting Vehicles.

The RSAF extensively uses overseas training bases such as Cazaux (advanced jet training) in France, Oakey (helicopter training) and RAAF Pearce (basic flight training) in Australia. In the US, RSAF CH-47D helicopter crews train at Grand Prairie, Texas through the Peace Prairie programme, F-16C/D training takes place at Luke AFB under the Peace Carvin II programme, F-15SG training takes place at Mountain Home AFB, Idaho, under the Peace Carvin V programme and AH-64D training takes place at Silverbell, Arizona, under the Peace Vanguard programme.

Singapore possesses one of the most impressive military capabilities in Southeast Asia; its armed forces are both well trained and well equipped. Perhaps more importantly, the Singapore Government remains committed to an ongoing policy of sustained investment in defence. Furthermore, should the strategic environment change in Southeast Asia, Singapore will increase its defence spending if it is necessary to preserve the ability of the SAF to deter aggression. ■

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Confronting Complexity

The Pakistan Armed Forces

David Saw

From the perspective of the Pakistan Armed Forces, it is obvious that they need to modernise their defence capabilities. Ideally, they would have access to state-of-the-art equipment from both foreign and domestic suppliers, with the indigenous defence industry also sustaining national defence capabilities through the provision of comprehensive maintenance, repair and overhaul services.

The problem is that achieving these modernisation goals requires money, and that is something that the Pakistani military and defence industry are not over-endowed with.

Unfortunately, funding is only one of the many problems that the Pakistan Armed Forces are facing. In fact, it would be fair to say that the only thing that the Pakistan Armed Forces is not short of is problems; they have an overwhelming threat matrix covering complex strategic challenges from both external and internal actors. It is not just the military that is confronting major problems; Pakistan as a nation state is troubled and has been for many years.

Since achieving independence on 14 August 1947, Pakistan has had to struggle against a dysfunctional political culture that has pervaded major state institutions including the judiciary. The failures of civilian rule have led to a situation where the military would step in, seeing themselves as the last line of defence for the nation, but coups and military governments did nothing for long-term stability in Pakistan. The military would eventually return to barracks, civilian rule and democracy would be restored and the whole circus would begin again until the next coup or crisis. More than that, there was inter-communal tension based on regional origin and deepening religious turmoil. Corruption was rife and the illegalities perpetrated by the wealthy and the connected were legion.

Author

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Photo: Heavy Industries Taxila

The AL-KHALID tank is a Sino-Pakistani joint venture design based on the Type 90 tank, built in Pakistan by Heavy Industries Taxila (HIT). Over 400 tanks are in service with the Pakistan Army. The Pakistan Army wishes to acquire large numbers of the upgraded AL-KHALID 2 variant of the tank.

The problems that Pakistan faces are not all of its own making, though. For 40 years, it has paid the price of having Afghanistan as a neighbour. The first Afghan refugees started entering Pakistan after the People's Democratic Party of Afghanistan (PDPA) Communist coup of April 1978. By June of 1979, a total of 109,000 refugees had been granted asylum in Pakistan. The second coup in Afghanistan by a faction of the PDPA in September 1979 saw refugee numbers increase to 193,000; by the end of 1979, there were over 300,000 refugees in Pakistan. Then at the end of December 1979 the Soviet Union intervened in Afghanistan in support of their client regime. This led to a major outflow of refugees into Pakistan. Between January and December 1980, between 80,000 and 90,000 refugees per month entered Pakistan. At the end of 1989, the UN High Commissioner for Refugees (UNHCR) stated that there were 3.27 million Afghan refugees in Pakistan, equivalent to more than three percent of the Pakistani population. The number of Afghan refugees in Pakistan from 1980 through to 2002 was the largest refugee population in the world at that time.

Afghan Involvement

In 1979, the strategic situation around Pakistan was chaotic. In early 1979, the Shah of Iran had fallen and the Islamic Republic came to power. At that point, nobody was certain of the course that the new Iranian regime would take. What was certain was that a major pro-Western power and a stabilising strategic force in the area was gone. Then came the Soviet invasion of Afghani-

Photo: Turkish Aerospace Industries

In July it was announced that Turkish Aerospace Industries (TAI) would supply the Pakistan Army with 30 T129 ATAK attack helicopters, with Turkey providing a US$1.5Bn funding package to support the deal. It now appears that the US is attempting to block the contract through denying clearance for the LHTEC engines used by the T-129.

stan. The last thing Pakistan wanted was Soviet troops on its doorstep. Even worse India, which Pakistan saw as an existential threat, was closely aligned to the Soviet Union, further increasing the threat. There was also the fear that Pakistan could itself become the target for Soviet ambitions.

While all of this was happening, Pakistan had a military government. General Muhammad Zia-ul-Haq, the Chief of Army Staff, staged a coup in July 1977 and overthrew Prime Minister Zulfikar Ali Bhutto (who was executed in 1979). After imposing martial law, Zia ruled as Chief Martial Law Administrator and then became President of Pakistan on 16 September 1978 and served in that role until his death in August 1988.

In the wake of the Soviet invasion of Afghanistan, Zia decided to support the Afghan Mujahideen and Pakistan's Inter-Services Intelligence (ISI) organisation would play a key role in the struggle against the Soviet Union. There was another important factor to take into account: After the Soviet invasion of Afghanistan, the US suddenly saw Pakistan as a critical frontline state. Prior to that, US military relations with Pakistan had gone through years of peaks and troughs.

Pakistan had signed a Mutual Defence Arrangement with the US in 1954 and had joined the SEATO (Southeast Asia Treaty Organisation) and CENTO (Central Treaty Organisation) defensive alliances at US prompting. This opened the door for Pakistan to receive extensive US military and economic aid. However, the 1965 Indo-Pakistan War saw the US place an arms embargo on both India and Pakistan. Pakistan remained the subject of a US arms embargo through the 1971 Indo-Pakistan War, with defence supplies only resuming in 1975 under the Ford administration.

After the 1971 War, the Bhutto government withdrew from SEATO. Bhutto's aim was to reduce dependence on the US. Despite the fact that there was an arms embargo, US economic assistance continued.

The fall of the Shah in early 1979 marked the end of CENTO, with US-Pakistani relations reaching a new low in April 1979 when the Carter administration halted all US assistance, apart from food aid to Pakistan, due to Pakistan's ongoing efforts to build a nuclear deterrent (India had tested a nuclear weapon in 1974). Then in November 1979 the US embassy in Islamabad was trashed by protestors. But in December 1979 the Soviet Union invaded Afghanistan. Suddenly Pakistan was important to the US and Pakistan needed US assistance. However, it was only after the inauguration of Ronald Reagan in January 1981 that Pakistan started to receive serious US assistance.

Many of the problems that confront Pakistan today can trace their roots back to the crisis in Afghanistan. There are refugee camps, Mujahideen camps, Inter-Services Intelligence (ISI) activities, foreign intelligence services running operations related to Afghanistan, narcotics trafficking (Afghanistan is a major producer of opium) and other forms of illegality. As the war in Afghanistan continued, US, Saudi and other money flowed into the area to fund the Mujahideen. Eventually, jihadists would flow into the area from around the world to join the struggle. Of course, the Afghan regime and Soviet forces would run intelligence and combat operations into Afghanistan as well. As such, Pakistan's western border area, which had always been somewhat lawless, became a true wild west!

Photo: via author

A YUAN class conventional submarine (SSK) of the Chinese People's Liberation Army Navy (PLAN). Under a US$5Bn contract agreed in July 2015 China will supply the Pakistan Navy with eight YUAN class submarines. Four will be built in China, with first deliveries in 2023, and four will be built in Pakistan, with deliveries completed in 2028.

Amidst all of the international efforts to help the Afghan Mujahideen, it was often forgotten that Pakistan had their own strategic interests in Afghanistan. Obviously, they did not want a hostile power on their border, hence the need to resist the Soviet-backed Kabul regime. What they wanted was a regime favourable to Pakistani interests or, even better, a client/allied government. This would give Pakistan strategic depth, offsetting the geographical weakness of Pakistan in this regard. The ISI, which had a central role in supplying weapons and logistic support to the Mujahideen, would ensure that the groups favourable to Pakistani interests were well provided for. Pakistani military advisors would also go into the field to support favoured groups as well.

When the last Soviet troops withdrew from Afghanistan in February 1989, their client Najibullah regime survived, but now the situation in Afghanistan was one of Civil War. Pakistani leader General Zia had died in August 1988 in a plane crash (in suspicious circumstances), which led to a return to civilian rule. The end of the Soviet presence in Afghanistan led to the end of US interest in that country and removed their need for Pakistan. The US Government would no longer certify that Pakistan did not have a nuclear weapons programme, and because of that, the Pressler Amendment (named after US Senator Larry Pressler) came into force in October 1990. This legislation banned economic and military assistance to Pakistan in an effort to stop nuclear proliferation. Once again, the US had abandoned Pakistan.

Russian assistance to the Najibullah regime in Afghanistan ended in 1992, leading to the fall of the regime. This opened the way for Mujahideen forces to enter Kabul and after the signature of the Peshawar Accords, a power-sharing arrangement was agreed for the new Afghan state. Not all of the Mujahideen groups joined the new government. The Hekmatyar faction (backed by the ISI), the Hizb-e wardat (backed by Iran) and the Ittihad-i Islami (backed by Saudi Arabia) all sought to fight against the new government and the Afghan Civil War continued.

Then, in 1994, a new force emerged in Afghanistan – the Taliban. Their aim was to establish a true Islamic state in Afghanistan and they attracted support from thousands of Afghan students studying at Madrassas (religious schools) in Pakistan who returned to Afghanistan to fight. The Taliban received massive ISI support, with ISI advisors present on the ground, and many Pakistani nationals went from the Madrassas to fight in Afghanistan with the Taliban. One estimate is that, between 1994 and 1999, between

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Photo: US Air Force

The most modern combat aircraft in the Pakistan Air Force inventory are 12 Lockheed Martin F-16C Block 52 (shown here) and six F-16D Block 52 aircraft delivered under the Peace Drive programme in 2010. Worsening relations with the US could cause problems, especially if spares deliveries are blocked.

80,000 and 100,000 Pakistanis joined with the Taliban. Religious fervour had been rising in Pakistan, creating an enormous manpower pool for Jihad in both Afghanistan and Kashmir. The downside of this large militant pool is that it would eventually be targeted against the Pakistan Government. As far as the Pakistani security situation is concerned, these militants now represent a serious ongoing internal security threat.

The Taliban made their first attempt to take Kabul in 1995 and failed with heavy losses. The next year saw them succeed and enter Kabul in September 1996. Resistance to the Taliban continued, but by 1998 they controlled 90% of Afghanistan. As far as Pakistan was concerned, this was a perfectly satisfactory result.

Nuclear Weapons

For Pakistan, the year 1998 was important for another reason: In the wake of Indian nuclear testing, Pakistan felt it had no option but to conduct its own nuclear tests and become a visible nuclear power. On 28 May 1998, the CHAGAL I test saw five devices detonated, with the CHAGAL II test on 30 May covering the detonation of a single 15 kt device. Pakistan is currently credited with between 100 and 150 nuclear warheads, with some estimates suggesting that the warhead stock could rise to between 220 and 250 weapons by 2025.

Initially, the delivery system for Pakistan's nuclear deterrent was the F-16A/B fighters of the Pakistan Air Force (PAF), although PAF MIRAGE aircraft were likely to have a nuclear delivery role as well. Pakistan has gone to great efforts to develop a complete range of ballistic and cruise missile delivery systems covering multiple range options. Pakistan has three Medium-Range Ballistic Missiles (MRBMs) types with ranges in excess of 2,000 km, one of which the SHAHEEN III has a range of 2,750 km. Other missile types range from battlefield systems with a range of 50 km, to short-range types with ranges out to 900 km and other systems offering ranges out to 1,800 km. Cruise missiles have been successfully developed and fielded, such as the BABUR ground-launched system (range out to 750 km) and the air-launched RA'AD system (range of 350 km). A submarine-launched cruise missile, the BABUR 3, has been successfully tested on multiple occasions and could be either in service or on the verge of entering service. Having air, ground and now sea-launched nuclear weapons gives Pakistan a robust strategic triad and a credible deterrent against India.

It must be stressed that the CHAGAL nuclear tests were conducted under a civilian government, as was the attack on Kargil in Indian Kashmir from May to July 1999, which brought India and Pakistan to the brink of a full-scale war. The nuclear tests put an end to attempts to repair relations with the US, with Kargil doing nothing to give Pakistan a positive image.

The Current Scene

Pakistan/US relations would be restored though. In the wake of the 9/11 terrorist attacks, Pakistan was given a stark choice, they could either join with the US or stand in opposition and face the consequences. Pakistan had no alternative but to assist the US in its War on Terror, but some 17 years later the conflict in Afghanistan still continues, and it is clear that this conflict has also led to the destabilisation and impoverishment of Pakistan. According to some estimates in Pakistan, the conflict in Afghanistan since 1979 has cost Pakistan some 60,000 lives and an economic loss of over US$250Bn.

The US seeks to manoeuvre Pakistan to support its interests. For example, in 1994 the US granted Pakistan the status of an important non-NATO ally and between 2002 and today Pakistan has received a total of US$33Bn in aid from the US. However, the US is still unable to realise that Pakistan has its own strategic concerns, which resulted in Congress blocking US$500M of Coalition Support Funds (CSF) destined for Pakistan earlier this year. More recently, the Trump administration cancelled an additional US$300M of CSF funding. This comes on

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top of the administration withholding other promised financial aid to Pakistan. The aim of this is to pressure the Pakistani military to take action against militant groups in Pakistan; CSF funding is designed to compensate Pakistan for these types of missions.

There is now another factor to take into account, the election of Imran Khan, leader of the Pakistan Tehreek-e-Insaf (PTI) as Prime Minister of Pakistan. Imran Khan was elected on the promise of 'Naya Pakistan' (New Pakistan), the aim is to tackle corruption and vested interests and come up with a society that meets the needs of its people, rather than just enriching a small elite.

The problem is that the Pakistani economy is in crisis, foreign exchange reserves are dangerously low and the country has enormous foreign debts on which it must make ongoing payments.

more pressure on the Pakistani government, as IMF medicine will hardly fit in with its populist policies.

With the government running out of money, that puts enormous pressure on the Pakistani military as a minimum of 34% of government expenditure is accounted for by defence spending (including military pensions). The defence budget rose some 200% between 2008/2009 and 2018/2019, according to Pakistani reports, from US$2.8Bn to US$8.9Bn. Despite this spending growth, the Pakistan military is actually under-funded to achieve the force modernisation goals that it has set to keep pace with potential threats. Any proposed cuts in defence spending will be resisted by the military and in Pakistan the record of civilian governments acting in opposition to the military has not been good.

These helicopters will eventually replace the Bell AH-1 currently in service with the Pakistani Army. The acquisition was to be funded with a US$1.5Bn loan facility from Turkey. Less than a month later, obstacles were being encountered: The T129 helicopter is powered by LHTEC CTS800 engines and the US is not helpful in licensing the engines for export to Pakistan. The fact that the US currently has issues with Turkey is hardly helping matters in this regard.

What Pakistan really needs at this point is good governance, an end to corruption, consistent economic growth and diversification, and, as a matter of increasing urgency, strenuous efforts to get the burden of foreign loans under control. Imran Khan will have to achieve this, while delivering on the populist elements of his 'Naya Pakistan' agenda. Failure to do so will lead to a rapid

Photo: via author

PNS ZULFIQUAR (251) was the first of four F-22P class frigates acquired by the Pakistan Navy from China, with three built at the Hudong-Zhinghua Shipyard in Shanghai, China, and the last frigate built at the Karachi Shipyard & Engineering Works in Pakistan. These frigates were commissioned between 2009 and 2013.

Pakistan will need to obtain a loan facility of between US$10Bn and US$12Bn in the short-term. If they go to the International Monetary Fund (IMF) this will be the 14th time the country has received emergency IMF assistance since the 1980s. Alternative options are to approach China for a loan, but Pakistan is already massively indebted to China, or Saudi Arabia. There are other problems with approaching the IMF. For example, the US could delay the loan package being agreed and insist on onerous terms. The IMF will also insist on public spending cuts and other harsh economic measures, all of which will put

Imran Khan is not a believer in Pakistan involving itself in supporting US objectives in Afghanistan, as such the dispute with the US seems set to continue. Unfortunately, this causes problems for the Pakistani military; the loss of US economic and military funding assistance is a major blow. The US can also put pressure on Pakistan by slowing the supply of spare parts and the delivery of new equipment.

The US also has other means of pressuring the Pakistan military. In July 2018, the Turkish Government announced that Pakistan had ordered 30 Turkish Aerospace Industries (TAI) T129 ATAK attack helicopters.

loss of confidence in the government.There must also be some effort to restore relations with the US, although it is difficult to see how this can be easily achieved. The inability to obtain spares for US equipment will be a negative factor for the Pakistani military. Fundamentally though, the issue for the Pakistani military is that they need significantly increased funding to improve their capabilities and, as things stand at present, Pakistan does not have the ability to boost defence spending unless other areas of government spending are cut. These are difficult times for Pakistan's new government. ■

Pakistani-US Defence Cooperation

Sidney E. Dean

Pakistan and the United States look back on seven decades of security cooperation. Objectively, both nations still benefit from continued partnership. However, domestic political pressures in Pakistan and shifting security policy priorities in both nations are straining the relationship, to the detriment of regional stability.

The United States recognised Pakistan on 15 August 1947, and immediately established diplomatic ties. By the early 1950s security and strategic concerns became critical aspects of the relationship. A Mutual Defence Assistance Agreement (MDAA) was signed in May 1954, resulting – among other things – in the establishment of a US Military Assistance Advisory Group in Pakistan and the training of Pakistani officers at US staff colleges. That same year, Pakistan joined the United States and six other allies in the South-East Asian Treaty Organisation (SEATO, dissolved 1977). In 1955 Pakistan also joined the Baghdad Pact (later known as the Central Treaty Organisation or CENTO); while the US was not a party to this mutual defence organisation, four other US allies were, and Washington retained close ties to CENTO until its dissolution in 1979. In 1959 US-Pakistani defence ties were reinforced once again through signing of a bilateral Agreement of Cooperation.

Photo: US DoD

Defense Secretary James N. Mattis meets with Pakistani Prime Minister Shahid Khaqan Abbasi during a visit to Islamabad, 4 December 2017. Mattis travelled to Egypt, Jordan, Pakistan and Kuwait to reaffirm the enduring US commitment to partnerships in the Middle East, West Africa and South Asia.

Strategic Value versus Strategic Weapons

Pakistan's location at the crossroads of the Middle East, Soviet Central Asia, China and the Indian subcontinent made it a particularly valuable partner for the United States. Throughout much of the Cold War Washington viewed Pakistan as a reliable partner working to counteract Soviet efforts in that region. Following Moscow's military intervention in Afghanistan, Karachi became Washington's prime conduit of support for anti-Soviet Mujaheedin. Pakistan also served as a regional counterbalance to India, which was largely aligned with the USSR. In turn, Karachi enjoyed the strategic protection afforded by the alliance with Washington, a relationship which – short of a world war – precluded direct Soviet intervention in any Indo-Pakistani conflict. The United States also supplied significant material and training assistance to Pakistan's armed forces, enabling the country to successfully stand up to its much larger rival India.

Despite the obvious commonality of interests, there have been low points in the bilateral relationship. Tensions briefly arose in the mid-1960s when the US reduced support to Islamabad in an effort to improve relations with New Delhi; Pakistan, perceiving the US to be an unreliable partner, began improving relations with both Russia and China. A decade later President Jimmy Carter placed sanctions on Pakistan over the latter's nuclear weapons programme. Fresh sanctions were imposed following Pakistan's nuclear weapons tests in 1998 and the military coup of 1999. In both cases, Washington suspended the sanctions when Islamabad's assistance was required following the Russian intervention in Afghanistan in late 1979 and after the 11 September, 2001, terrorist attacks on the United States.

Major Ally

In 2004, Washington elevated Islamabad to the status of major non-NATO ally, the same designation enjoyed by such partners as Australia and Japan. "On behalf of President Bush and the American people, I came to say that the United States is committed to a long-term partnership with Pakistan," then Secretary of State Colin Powell declared in Islamabad. "I believe that in the current environment we have every opportunity to strengthen that relationship in strategic ways as we move forward." At the practical level this new status eased and prioritised Pakistan's access to US-manufactured weapon systems and other military technology, and provided for loan

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Photo: US DoD

US Secretary of Defense James N. Mattis met with Pakistan Ambassador Ali Jehangir Siddiqui at the Pentagon in Washington, DC on 30 July 2018.

guarantees and grants to facilitate these purchases. The major ally status also paved the way for increased training support and intelligence sharing.

A formal US-Pakistan Strategic Dialogue was initiated in 2010. According to the US State Department, the Strategic Dialogue is intended to provide the vision and framework for the "bilateral partnership in core areas of joint interest and cooperation." The Dialogue framework includes annual meetings of the foreign ministers, as well as six subject matter working groups: 1) Energy; 2) Security, Strategic Stability, and Non-proliferation; 3) the Defence Consultative Group; 4) Law Enforcement and Counterterrorism; 5) Economics and Finance; and 6) Education, Science, and Technology.

Counterterrorism as a Defining Factor

Despite the broad-based and comprehensive nature of the formal alliance, counterterrorism and counterinsurgency have come to define the current security relationship ever since 9/11. This is especially so from Washington's viewpoint. The US Government points to Pakistani pledges to deny safe haven to all militant groups and to prevent attacks emanating from Pakistani soil. Of particular interest are the Federally Administered Tribal Areas (FATA) located on the Afghan border of north-western Pakistan, an area which has long been beyond complete control of the central government. According to the State Department, US security assistance to Pakistan is focused on "strengthening the counterterrorism (CT) and counterinsurgency (COIN) capabilities of the Pakistan security forces, and promoting closer security ties and interoperability with the United States. US security assistance has directly supported Pakistan's CT operations in the FATA. Foreign Military Financing (FMF) (US$255M in FY 2016) promotes the development of Pakistan's long-term COIN/CT capabilities and improves Pakistan's ability to participate in maritime security operations and counter-maritime piracy. International Military Education and Training (IMET) assistance to Pakistan (US$5M in FY 2016) enhances the professionalism of Pakistan's military and strengthens long-term military relationships between Pakistan and the United States."

As noted in this summary, the partnership extends to maritime security with a focus on preventing and combating seaborne terrorism as well as arms and drug smuggling in the north-western Indian Ocean. The navies of both nations regularly train together, including US participation in the multinational annual AMAN exercises conducted by the Pakistan Navy. In March 2017, Pakistan's Chief of Naval Staff, Admiral Mohammad Zakaullah, was awarded the Legion of Merit during a visit to Washington. During the ceremony US Navy Chief of Naval Operations Admiral John Richardson lauded the Pakistani Navy's contributions to the war on terrorism and its contributions to regional stability.

Photo: US Navy

Rear Adm. Jeffrey A. Harley, President of US Naval War College, met Pakistan Navy Adm. Muhammad Zakaullah during a visit to Newport, RI on 13 March 2017. The visit was in response to an invitation sent to foreign navy counterparts to come to the United States for a familiarisation with the US Navy.

Recent Strains

Despite these positive displays, political relations between Karachi and Washington have suffered again in recent years. The Obama administration, as part of its strategy to contain an expansionist China, began a concerted effort to win over India as a strategic partner. These overtures to Pakistan's fiercest rival inevitably sat poorly with Islamabad. And anger flared in both capitals following the 2011 raid on Osama bin Laden's compound in Abbotabad. Islamabad displayed outrage over the covert US raid on Pakistani territory. For its part, Washington could not believe Islamabad's assertions of ignorance concerning the al Qaeda leader's presence in a city housing the Pakistani military academy and home to senior military officers; many in Washington openly questioned whether Pakistan could still be viewed as a partner in the war on terrorism. Misdirected US air strikes in November 2011, which killed 36 Pakistani border guards, further inflamed tensions, with some Pakistanis believing the attacks were targeted as a means of punishing Islamabad. The bilateral Strategic Dialogue was suspended for three years, resuming again in 2014. US security assistance funds, which the Obama administration had increased to the unprecedented level of two billion dollars annually, were cut by two-thirds.

The greatest long-term damage, however, could result from the perception that Islamabad's campaign against insurgents operating from the FATA has slackened. The problem extends well beyond mere inaction; as far back as the G. W. Bush administration, US intelligence agencies con-

cluded that the Pakistani government – or elements of Pakistani security agencies – actively cooperated with the Taliban-allied Haqqani network and other insurgent or terrorist groups operating out of the FATA.

Working-Level Talks

At the working level, the Pentagon has tried a low-key approach, engaging Pakistani leaders in behind-closed-doors dialogue. Public statements by defence department leaders, while letting through Washington's dissatisfaction, have mostly been formulated to enable Islamabad to return to full cooperation without losing face. In early 2017, US Defence Secretary James Mattis recognised the significant sacrifices the Pakistan military has made in the past in the Federally Administered Tribal Areas, and he expressed appreciation for the Pakistan military's recent support for efforts to defeat the ISIS-Khorasan group operating in Afghanistan and Pakistan. In a conversation with Pakistani Army Chief of Staff General Qamar Javed Bajwa, both leaders reaffirmed the importance of the bilateral military-to-military relationship, and highlighted the importance of continuing to work together on counterterrorism and regional stability.

A year later, that cooperation had failed to materialise, but Mattis' public statements continued to have an understated tone, stating on 5 January 2018 that the US has "had strong disagreements [with Pakistan] on some issues, and we're working those. The specific individual things we're doing are best handled in private, to ensure that we can be most productive – and that's what we're working now."

Photo: US Navy

Pakistan Chief of Naval Staff Adm. M. Asif Sandila (centre), Rear Adm. Daryl Caudle (left), and Capt. Andrew J. Loiselle, commanding officer of the aircraft carrier USS GEORGE H.W. BUSH (CVN 77), discussing shipboard operations in flight deck control on 18 September 2018

Trump Administration Goes on the Offensive

President Trump has taken a completely different approach than Secretary Mattis. "Today, 20 US-designated foreign terrorist organisations are active in Afghanistan and Pakistan, the highest concentration in any region anywhere in the world," the president said on 21 August 2017. "For its part, Pakistan often gives safe haven to agents of chaos, violence and terror. (...) No partnership can survive a country's harbouring of militants and terrorists who target US service members and officials," Trump said. "It is time for Pakistan to demonstrate its commitment to civilisation, order and to peace."

On 4 January 2018, the Trump administration upped the ante by suspending almost all military aid. "Pakistan has played a double game for years," US United Nations Ambassador Nikki Haley told reporters at the time. "They work with us at times, and they also harbour the terrorists that attack our troops in Afghanistan."

The suspension includes freezing US$900M of support funding designated for the Pakistan Armed Forces. Pakistani officers will also be barred from US military staff schools and other training opportunities in the United States. Washington continues to stress its desire for continued partnership, portraying the suspension as a measure forced upon the US by Pakistani intransigence. "Our expectations are straightforward: Taliban and Haqqani leadership and attack planners should no longer be able to find safe haven or conduct operations from Pakistani soil," said Pentagon spokesman Colonel Robert Manning on 8 January. "The United States has conveyed to Pakistan specific and concrete steps that it could take toward these ends," Manning said, adding, "We stand ready to work together with Pakistan to combat terrorist groups without distinction."

Photo: US Navy

Marines of the 22nd Marine Expeditionary Unit, along with Marines from Kuwait and Pakistan, conducting an amphibious assault demonstration during Exercise BRIGHT STAR in 2009

Pakistani Response

While Washington's complaints are nothing new, no US administration has presented them as directly or aggressively as the current one. The US suspensions remain in place, and it is difficult to predict when they will be lifted or amended. Islamabad continues to deny the US allegations of inactivity and complicity vis-a-vis insurgent activity, and denies that a Taliban presence even exists in Pakistan. Prime Minister Shahid Khaqan Abassi has warned that degrading Pakistan's armed forces would ultimately degrade US strength in the region.

Beyond the practical implications of the suspensions, Islamabad criticises them as offensive and dishonourable. Pakistani leaders point out that their country has

sacrificed tens of thousands of military and civilian lives to the war on terrorism – far more than the United States or any other outside partner active in Afghanistan. Secretary Mattis has acknowledged this repeatedly – presumably in an effort to dampen the tone in Washington.

For its part, Pakistan complains that US cooperation has long been inconsistent, and is used to pressure Pakistan to conform to shifting US priorities. From Islamabad's perspective, the Trump administration's efforts to woo India as an ally, increase arms exports to New Delhi, and intensify India's role in stabilising Afghanistan are also viewed as a threat. From the US perspective, there is no contradiction between partnering with both Pakistan and India, but both Islamabad and New Delhi continue to consider this a zero-sum game. For Islamabad, US courtship of India remains synonymous with a slackening of commitment to Pakistan, while the prospect of Indian presence and influence in Afghanistan also raises fears of encirclement.

These concerns have many leaders advocating diversification of Islamabad's security relationships. One sign of the old alliance's decline is the fact that the value of US arms sales and transfers to Pakistan has dropped by 76% between 2013 and 2017, as reported by the Stockholm International Peace Research Institute (SIPRI). The think tank's latest global arms transfer report found that Washington has fallen to second place behind Peking, which in 2017 supplied 70% of Islamabad's military technology.

Prospects after Imran Khan's Election

After the initial outrage over the suspensions cooled, Pakistani Government statements became businesslike, stressing the desire to work with Washington to eliminate what they termed misperceptions of Pakistani policy. However, the recent election of Imran Khan as Prime Minister could complicate matters further. The new prime minister campaigned on a populist agenda which some in his own nation have defined as "Pakistan First". An anti-American tone was a hallmark of his foreign policy platform before the election. Following his election in August, Imran Khan did signal a potential softening of his position, declaring his wish to improve relations with the United States. Domestic analysts speculate that Khan's victory was facilitated by support from the nation's armed forces. Many of Pakistan's current military leaders were educated in the United States and could – despite the perceived erosion of trust – retain an appreciation of the benefits of close ties to Washington.

However, a minor diplomatic row in late August documents that tensions are far from resolved. Following a telephone conversation between PM Khan and US Secretary of State Mike Pompeo, both nations disputed the other's description of events. On the one hand, the US State Department announced that Pompeo wished Khan success and also asked Khan to take "decisive action against all terrorists operating in Pakistan". On the other hand, the Pakistani foreign ministry firmly denied that "terrorists operating from Pakistan" had been a topic of discussion, and demanded a correction. The US stood by its claim. While seemingly trivial, this exchange signals that bilateral tensions are far from over. With two strong-willed – or perhaps wilful – leaders, neither of whom has worked his way up the conventional political career path, there remains a danger that short-sighted decisions will further strain the relationship and endanger future security cooperation.

Photo: USAF

In 1957, Pakistan agreed to allow the United States to launch U-2 reconnaissance flights from a base in Peshawar. The aircraft piloted by Francis Gary Powers and shot down over the USSR in 1960 was one such flight. The US Air Force and CIA returned Peshawar Air Base to the Pakistani armed forces in 1970.

Cool Heads or Cold War?

Calls to designate Islamabad a state sponsor of terrorism have been heard in the United States Congress; India and Afghanistan, both eager to weaken ties between Washington and their rival neighbour Pakistan, are also lobbying for such a step. Last year, then-Secretary of State Rex Tillerson publicly mused about revoking Pakistan's status as a major non-NATO ally. In reality, such a break would remove what leverage Washington has in Islamabad and would do nothing to rectify the security threats based in the FATA. Washington would be hard pressed to find a replacement partner in the region, as Afghanistan remains highly unstable and India continues to evade a major commitment to a US alliance. At the most practical level, it would seriously undermine US and coalition operations in Afghanistan, since Pakistan remains the prime resupply corridor for coalition forces; and while relations are strained, Pakistani agencies do continue to supply at least some intelligence on militant groups operating in Afghanistan.

For its part, Pakistan is aware that it has received US$34Bn in military aid from the United States since 2002. Russia, China and even Saudi Arabia stand ready to move into the vacuum that would ensue from a US–Pakistani divorce, and all would happily equip and train the Pakistani military. However, Moscow and Peking would exact their own geopolitical price from Pakistan and would ultimately enforce their agenda much more vigorously than Washington has ever done.

At the core, both the United States and Pakistan must realise that their fundamental security interests are best served through continuation of the bilateral security partnership. These thoughts were echoed by Pakistan's Ambassador to the US, Ali Jehangir Siddiqui, who in August warned of writing off the alliance. "Its importance has been proven over decades," he said. "We are working on fixing it." ■

Turkey and Pakistan: A Long-Standing Friendship

Korhan Özkilinc

Security and defence cooperation between the two countries goes back many years. In their respective regions, both countries play a similar strategic role and pursue similar objectives.

In his book "America's Strategy in World Politics" of 1942 and in his second book on "The Geography of Peace" of 1944, the US geostrategist Nicholas John Spykman analysed US security policy and the balance of power in the Eurasian region. He argues that peace can only be enforced through effective (aggressive) foreign policy by suppressing the aggression of other countries, an argument which made Spykman the Spiritual Father of containment policy. Since 1947, containment has been anchored strategically and tactically in US foreign policy, which is clearly visible in later years when looking at US military alliances.

Graphic: mawibo media

To curb Soviet influence, in 1949 the United States founded NATO (North Atlantic Treaty Organization) as a military defence alliance stretching from Norway to Turkey; in 1955 CENTO (Central Treaty Organization) was founded, stretching from Turkey to Pakistan; and in 1954 SEATO (Southeast Asia Treaty Organization), stretching from Pakistan to New Zealand.

Two countries play an important role in this strategic encirclement of Eurasia: Turkey and Pakistan. Turkey was the indispensable link between NATO and CENTO and Pakistan the indispensable link between CENTO and SEATO. Although CENTO and SEATO no longer exist and the two countries are no longer on the same wavelength with current US foreign policy as in the past, they nevertheless play a special role in US foreign policy. It is therefore important to take a close look at the historical development of cooperation between Turkey and Pakistan.

Photo: Pakistan Defence

When meeting with Turkish President Erdogan after the failed 2016 coup d'état, Pakistan's ambassador to Turkey Sohail Mahmood said that, "The enemies of Turkey are enemies of Pakistan."

Cooperation in Security Policy

The friendship of both countries goes back to the time before the foundation of both states, namely when the Pakistani people provided great financial aid to the declining Ottoman Empire during the Turkish War of Independence from 1919 to 1923. To this day, the Turks are very grateful to the Pakistani people for their sacrifice and are politically, economically and militarily ready to help their brothers at any time.

After the War of Liberation in 1923, Turkey was founded by Mustafa Kemal Atatürk according to Western and secular principles and this Turkish model was highly appreciated by Pakistan's founding father Muhammed Ali Jinnah. Turkey established diplomatic relations with Pakistan shortly after Pakistan's independence in 1947 to promote economic and cultural cooperation.

Turkey and Pakistan signed the "Treaty of Eternal Friendship" in 1951 and three years later the "Treaty of Friendship and Cooperation" on 2 April 1954. With the two agreements, both countries strengthened and underpinned their security relations for the next decades. At that time, Turkey

became a member of NATO's military alliance in 1952 and Pakistan received American military assistance from 1954. In addition, both countries became members of CENTO, Turkey on 24 February 1955 and Pakistan on 23 September 1955. The aim was to contain Soviet influence. This military alliance could be maintained until 1979, when political changes in the member states led to the dissolution of CENTO. Turkish-Pakistani solidarity was clearly visible in 1965, when Turkey was punished and embargoed by the USA during the 1964 Cyprus conflict and Pakistan during the 1965 Indo-Pakistan war, which is why the two countries cooperated with Iran and founded the Organization for Regional Cooperation and Development (ORCD) in 1965. This organisation was dissolved in 1979 and its successor, the Organisation for Economic Cooperation (ECO), was founded in 1985.

Both Pakistan and Turkey have entered world politics with the intention of developing a security policy that is independent of the USA in order to further promote their national security interests. This intention can still be seen today in the policies of both states towards the EU and the USA. Mutual support continued after 1970, when Turkey openly side with Pakistan in the Kashmir conflict and considered the controversial Kashmir and Jammu areas to be part of Pakistan. In return, Pakistan provided Turkey with political and logistical support in the 1974 Cyprus conflict.

Photo: Patrick Fisher

The enlargement of the deep-water port in Gwadar in southern Pakistan is a flagship project of China's BRI initiative.

Since 2000, Pakistan and Turkey have often met bilaterally and sometimes trilaterally and signed more than 100 treaties. Cooperation is further strengthened by membership in the Organisation for Economic Cooperation and Development (D-8). On a bilateral basis, the two countries work together in the economic sphere, in the fight against international terrorism and in relations with the Central Asian states; mutual support in the conflicts over Cyprus and Kashmir is not neglected, but Turkey supports the peaceful resolution of the conflict between Pakistan and India. At the trilateral level, in particular with Afghanistan, regional stability and security are addressed so that economic development and the fight against international terrorism can continue. When compared internationally, Turkey and Pakistan bear the main burden in the region when it comes to combating international terrorist groups such as Al Qaeda, the Taliban, PKK, PYD, IS and others. This should be recognised by the international community.

Security Policy in the Overall Context

Pakistan and Turkey have similar relations with the Eurasian powers, which is why their geopolitical roles can be compared. Today, Asia is dominated by the two major Eurasian powers – the Russian-dominated Eurasian Economic Union (EEU) and the Chinese Silk Road Economic Belt Strategy. China's Belt and Road Initiative (BRI) and the strategic project One Road One Belt (OROB) attempt to connect the Chinese Pacific coast with Europe and the Atlantic coast.

Pakistan is the centrepiece of the large-scale BRI. China has created the China-Pakistan Economic Corridor (CPEC) with Pakistan, a mega-project, and is committed to investing more than US$60Bn in a 2,700-kilometre belt of Pakistan's infrastructure, that is, road rail and port projects. The flagship of this mega-project is the enlargement of the deep-water port in Gwadar in southern Pakistan and its connection to Kashgar (Turkish-dominated region) in the Xinjiang region of western China. Of course, there will be conflicts with local ethnic groups in this corridor. But China will bring this project to a successful conclusion with an iron hand, as the USA has recently been steadily expanding its military relations with India. However, India recently bought S-400 BMD and four frigates from Russia, which means that India could also be sanctioned by the US, making Pakistan even more important for both China and the US in the future. Nevertheless, China will upgrade the Gwadar port to a naval base and establish an air base in Jiwani near the Iranian border.

Turkey's relations with Russia in Western Eurasia are the same as Pakistan's relations with China. Turkey's strategic location is of great importance for the transport of Russian oil and gas. In addition, Turkey has access control over the Bosporus and the Dardanelles, which are important to the Russian Navy. In addition, Russia has made a commitment to sell the S-400 BMD to Turkey. The Turkish and Russian military will certainly not cooperate as closely as the Chinese and Pakistani military, but the unilateral approach of the USA in Syria and close cooperation with the Kurdish terrorist organisation PKK in Syria will further promote cooperation between Russia and Turkey.

In return, however, the US is trying to make up for lost ground by drawing closer to its main NATO partner Turkey, although relations are strained by the US policy in Syria and recent developments with Pakistan. Over the past 15 years, Pakistan has received US$33Bn in military and economic assistance from the US on a bilateral basis, on the condition of fighting the Taliban. However, the US did not see progress in a satisfactory manner and cooperation between the two countries was put on hold. At the beginning of September this year, US Secretary of State Mike Pompeo visited the new government under Prime Minister Imran Khan with the Chairman of the Joint Chiefs of Staff Joseph Dunford. Pompeo

spoke of "resetting the relationship" with Pakistan, and Pakistani Foreign Minister Shah Mehmood Qureshi even spoke of "creating a fresh start for our bilateral relationship".
The US knows how important Turkey and Pakistan are as strategic hubs and in the fight against international terrorism. Both Ankara and Islamabad have combated international terrorism in the past and paid for it with high death tolls. In addition, Pakistan and Turkey are becoming increasingly important for the USA because of their proximity to Iran. Iran, Pakistan and Turkey founded the Economic Cooperation Organization (ECO) in 1985, which currently consists of 10 countries, and the influence of these countries on the Silk Road is growing steadily. But one thing is certain: Neither Turkey nor Pakistan will be a US extension against Iran.

Photo: US Department of State

On 5 September 2018, US Secretary of State Michael R. Pompeo met with Pakistan's Prime Minister Imran Khan in Islamabad in an attempt to improve the strained relationship.

Cooperation in Defence Industry

Pakistan and Turkey have long maintained military relations, and high-ranking military delegations often meet in Ankara and Islamabad. Pakistani officers and officer candidates are trained at Turkish military academies and both countries participate in joint military exercises. There is also intensive cooperation in the arms industry, although Turks follow NATO standards and the Pakistani military follows Chinese standards, but there is a growing tendency on both sides to cooperate more.
Pakistan's arms industry had a tough start in terms of its development history. After the founding of the state of Pakistan in 1947, all arms industries that had previously been under colonial rule were on the Indian side. In the beginning, the country had no military infrastructure and survived only with the support of allied countries. In September 1951, with the help of the British Royal Ordnance, the Pakistan Ordnance Factories were founded with the aim of assisting the Pakistani military in forming a sovereign army. Since then, the network has grown to include more than 20 state-owned companies and over 100 private sector companies.
Defence cooperation between Turkey and Pakistan began in the 1990s: in 1995, Turkey supplied the Pakistani Army with 50 SHORLAND APVs, in 2008 with 12 self-propelled howitzers T-155mm, and in 2011-2013 with another 60 howitzers.
In the recent past, Pakistani air force officers have been trained in Turkey and the F-16 fleet has been modernised in Turkey. The first of a total of 41 F-16s was upgraded between 2009 and 2014 with the participation of Pakistani colleagues. One year later, in 2015, Turkey sold 34 Cessna T-37B trainer aircraft from its fleet to the Pakistan Air Force. To increase the effectiveness of the Pakistan Air Force, a total of 24 ASELPOD (Electro-optical reconnaissance, surveillance and targeting system) aircraft of the ASELSAN brand were integrated into the Pakistani JF-17 fighter aircraft in two tranches in 2017. In return, Turkey has ordered 52 PAC MFI-17 MUSHSHAK trainer aircraft from Pakistan, which will be delivered to the Turkish Air Force from 2019.
In 2007 and 2008, the Pakistan Navy received two MRTP-33 attack aircraft. In 2016, the Turkish company STM placed an order with Karachi Shipyard & Engineering Works Limited for a 155-metre-long navy oiler. The same Turkish company has been awarded the contract to modernise Pakistan's AGOSTA 90B submarine class.
The most recent achievement for the Turkish defence industry was the agreement between the Turkish ASFAT AS (Military Factory and Shipyard Management Inc.) and the Pakistan Ordnance Factories. The agreement was published on 5 July, 2018, and concerns the supply of four MILGEM corvettes for the Pakistan Navy worth over US$1Bn. The first and third corvettes will be produced in Turkey and the second and fourth corvettes in Karachi, Pakistan, while the last corvettes will also be essentially technology transferred. All four corvettes will be delivered as from 2023.
A week later, both countries signed an agreement to supply 30 T129 attack helicopters to the Pakistani Army worth more than US$1.5Bn. The T-129 was tested under difficult conditions by Pakistani military personnel. This deal also applies to the Turkish T-625 project for a twin-engine light transport and supply helicopter.
Pakistan and Turkey are constantly looking for new ways to improve cooperation in the defence sector, such as in communication technology and space. The replacement of the obsolete M-113 APC by the new Turkish APVs, such as the MBT ALTAY, is currently under discussion.
The cooperation of both countries brings enormous advantages for both sides. For the Turkish side, not only will new target markets be opened up, but Turkish companies will also be able to develop defence

technologies for different geographical conditions. For the Pakistani side, this means learning new skills and adapting to Western standards, a process that has been underway for a long time. In general, Pakistan and Turkey are creating stability in the region through their defence cooperation, and cooperation is expected to be further deepened.

Conclusion

Under the leadership of Colin Powell, the US State Department announced in 2002 the Middle East Partnership Initiative (MEPI) to help opponents of regimes that violate human rights and freedom in the Middle East and North Africa. Essentially, MEPI's main task was "to promote democracy in the Arab world". According to Condoleezza Rice, the US President's security advisor, this partnership initiative constituted "transformative diplomacy". On 7 August, 2003, she published an article in the Washington Post entitled "Transforming the Middle East", in which she called on the United States and its allies to engage in the long-term transformation of the 22 countries in the Middle East with the goal of spreading democratic values and economic stability.

In principle, the Partnership Initiative of 2002 is a strategic complement to the Silk Road Strategy Act of 1999. The strategic proposal empowers the USA to provide humanitarian and economic support to the Central Asian countries and the SAFARI, promote democracy and economic stability and thus strengthen the influence of the USA in these regions.

Photo: Kurush Pawar

The MFI-17 MUSHSHAK is a licence-built trainer aircraft version of the Saab SAFARI used by the Pakistan Air Force. It is manufactured in Kamra, Pakistan, by Pakistan Aeronautical Complex (PAC).

After 15 years, the US Government is now working on the formation of a new security alliance consisting of six Arab Gulf states Saudi Arabia, Bahrain, Oman, UAE, Qatar, Kuwait, Egypt and Jordan (unofficially called "Arab NATO"). This time it is not about democratisation and economic stability, but about the containment of Iranian aggression and terrorism and of course about the stabilisation of US foreign policy in the Middle East.

Therefore, the United States has recently sold a lot of military equipment in this region, although these countries are allies of the United States, but major competitors amongst themselves. In other words, the United States benefits from arms deals and the supply of cheap oil to the United States, but all in all the US Middle East policy has failed and in Central Asia Russia and China dominate with massive economic and military strength.

A new foundation of CENTO in the economic sense and the positive influence of the USA on ECO would help more than the current aggressive approach. It should not be forgotten that Pakistan and Turkey have a great influence on the region due to their historical friendship with Afghanistan, which has been demonstrated in the past in solving Kabul's domestic problems. In general, the USA could make up for its lost position in the Middle East and Central Asia, with Iran in particular being in the focus, but the USA should first give up its America First stance. ■

Photo: Milborne One

In July 2018, Turkey and Pakistan signed an agreement, worth more than US$1.5Bn, to supply 30 TAI/Augusta Westland T129 attack helicopters to the Pakistani Army.

"This is the largest occupation force anywhere in the world."

Views on the Kashmir conflict by H.E. Sardar Masood Khan, President of Pakistani Azad Jammu and Kashmir (AJK)

Photo: Georg Mader

President Khan during the interview with Georg Mader of ESD

The Kashmir conflict is a territorial dispute between India and Pakistan, ignited just after the partition of India in 1947. India and Pakistan have fought three wars over Kashmir, including the Indo-Pakistani wars of 1947 and 1965, as well as the Kargil war of 1999. The two countries also have been involved in several skirmishes over control of the Siachen Glacier. India claims the entire princely state of Jammu and Kashmir and, as of 2010, administers app. 43% of the region – Jammu, the Kashmir Valley, Ladakh and the Siachen Glacier. India's claims are contested by Pakistan, which administers approximately 37% of the region, namely Azad Kashmir and Jammu (AJK) and Gilgit-Baltistan. The Kashmir Valley is a hotbed of the current conflict and is rooted in the conflict between Kashmiri insurgents and Islamist groups, which the Indian security forces claim are supported by Pakistan. The Pakistani President of Kashmir bitterly explains to Georg Mader of ESD how violence and clashes are linked to the "unfinished business" of local autonomy as the UN resolutions support the demand for self-determination for the entire state of Jammu and Kashmir. Regarding his drastic accusations against India, the author notes that India's view of the conflict will also be presented here in the future. The conflict in Kashmir may be forgotten, but it is certainly not frozen.

ESD: Y.E., Mr. President, Recently, a Pakistani who made it to Sarajevo in Bosnia said that "because of the tension in Kashmir last year, he sold everything to live a decent life in Italy, Austria or Germany." Is it really so unpleasant or dangerous in your country that ordinary people from Pakistan-controlled AJK – obviously not the typical refugees – are migrating to distant Europe?
S.M. KHAN: Well, what is "my country"? I guess he is not from our territory, AJK. But in Indian-occupied Kashmir – IOC, as we call it – there is violence and consistent violations of human rights. AJK is comparatively peaceful, low in crime, developing economically, and so on. But it is quite possible that he could not bear the brutality of the Indian occupying forces in IOC with various arrests and even extrajudicial killings. Or their use of pellet guns, for example, which has blinded 1,200 to 1,400 people completely or partially. On the other hand, we also have a large diaspora like in Great Britain, with about 1.2 million Kashmiris who have gone to Britain since the 1960s and 1970s and are now among of the millions of Britons of Pakistani origin. When individuals want to come from AJK to Europe, the USA or the Gulf region, they often have relatives or friends there, such as in communities in Germany, Belgium, France, and so on. But in general you are right; they are migrants for economic reasons or in search of better living conditions, but of course not genuine refugees on the basis of the Geneva Convention.

ESD: Would you agree that the problems and contradictory claims about Kashmir are "unfinished business" from the 1947 partition and Kashmir's final status should have been determined by the people of Kashmir decades ago by referendum? And India rejects this until today? So is there little optimism for an agreement today, but rather more pessimism?
S.M. KHAN: You are right, the issues around Jammu and Kashmir are "unfinished business" of the partition of India and Pakistan 70 years ago. From our point of view, all the UN resolutions remain valid but have not been implemented. This includes the objective of a referendum in which the whole of Kashmir will ultimately decide whether it belongs to India or Pakistan. Pakistan and the people of Jammu and Kashmir are ready to negotiate; they are ready to implement these resolutions. It was India that brought Kashmir to the UN Security Council, but then they withdrew and tried to integrate IOC territory into their state. But they didn't succeed. Seventy years and massive human rights violations later, the Kashmiris have not bowed to the occupation of their territory by the 700,000 Indian troops.

ESD: Really, 700,000?
S.M. KHAN: Oh, yes, it's the greatest occupying power in the world. India may deny this figure, but according to our count, that is the right figure. The Indians would probably report their armed forces at half a million, but not including MPs, paramilitary forces, riot police, central reserve police, and so on. And of course the Jammu and Kashmir police. All together brutalise the Kashmiris. Most of the oppression by them takes place in the Kashmir Valley, but there is turbulence again and again in Jammu as well.

ESD: Is the impression misleading that thousands of battle-tested foreign mujahideen came to Kashmir after the Soviet invasion of Afghanistan in 1989, and that their successors call Kashmir's liberation a jihad?
S.M. KHAN: Your 'impression' supports the Indian narrative. For the past 70 years, Kashmiris have been dissatisfied with Indian rule. While the Mujahedeen once were a factor, it was not Afghanistan as a whole. Delhi had sabotaged electoral processes, causing

Unprecedented Bullet Resistance

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Photo: WELP

Anyone developing and manufacturing civilian armoured vehicles must have complex expertise in the individualisation of vehicles. On the one hand, the visual appearance and ergonomics of the basic vehicle must be maintained while on the other, the vehicles must offer adequate protection against firearms and explosions.
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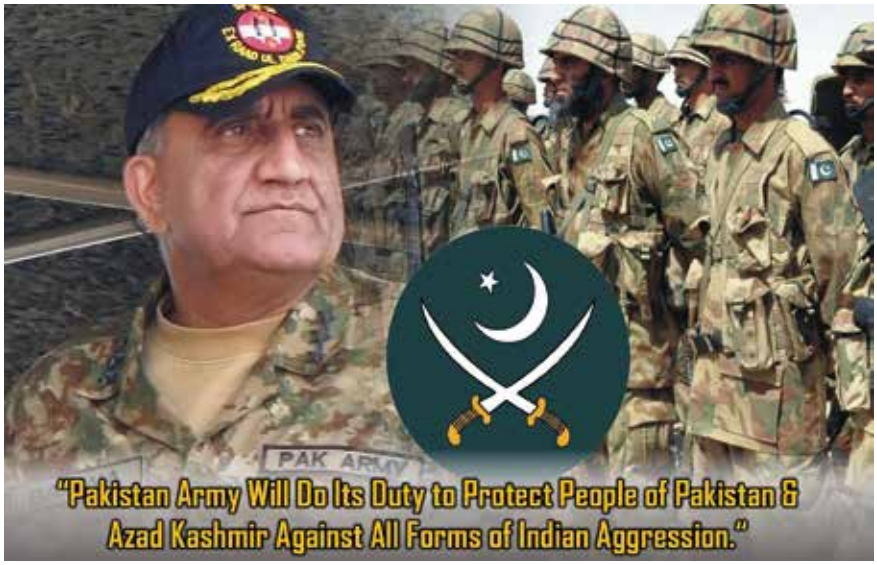
Photo: AJK Media Relations



A propaganda poster of the Government from Azad Jammu and Kashmir.

widespread anger, and the Indians brutally suppressed the subsequent demonstrations between 1987 and 1989. Some Kashmiris then decided to take up arms. This was an indigenous, armed resistance or freedom movement, if you like, and it was not initiated by the foreign mujahideen. And that is basically still the case today.

ESD: But Mr. President, we all know, the mujahideen were there. And Muslim fighters are still there. So from your point of view, the Kashmir conflict was never really a religious Muslim/Hindi issue?
S.M. KHAN: As I have said before, these foreign fighters became a factor when they joined in later on, when they saw their local Muslim brothers suppressed and slaughtered. And yes, there was and is a religious component to the conflict as well. This has to do with a local Hindu minority in Kashmir. And the tensions between the Muslims and the so-called "Pandits" increased, as the occupation altered the traditionally normal relations between people who were previously neighbours. By exploiting religion, India was able to show the world that the conflict was about imported religious fanaticism and sectarian violence and not about the right of self-determination of the Kashmiris, who are ruled against their free will.

ESD: So, it is all about self-determination, without any ethnical or religious factors?
S.M. KHAN: Yes, of course! The struggle for the right to self-determination is widespread among the population. It is hard to bear that the Indian side has militarised the whole issue, while Pakistan has long pursued a diplomatic solution, either through the UN or bilaterally. The AJK territories with their representatives, their local courts and structures are waiting for the day when the whole area can exercise its political will. And the people along the Line of Contact (LoC) suffer every day because of this enemy fire from India. Of course we can retaliate, but we cannot take action against the civilian population, against our own citizens.

ESD: Wait a minute, it's not like the LoC between Azerbaijan and Armenia that I visited last year but civilians live there?
S.M. KHAN: Yes, there is no buffer-zone or something similar. In many cases it would be a long and complex issue to re-settle or re-locate them. They have their possessions there, their graveyards, and so on. The population does not want to leave, but the Indians are targeting them, knowing that we cannot retaliate as they are our own folks.

ESD: You've mentioned 'hostile fire from India'. An Indian colleague from IHS-Jane's just last week cited an Indian figure of 881 violations committed by the Pakistani forces between January and May, 21 more violations than during the the entire year 2017. On 10 January 2018, India reported that in 2017 it killed 138 Pakistani soldiers and so-called terrorists along the LoC and injured 155 others. During the same period, the Indian government announced that 28 Indian soldiers were killed in action and another 70 wounded in battle along the LoC.
S.M. KHAN: We have over 1,000 such incidents. Every month soldiers on both sides and freedom fighters are killed, but also civilians. This is a very sad loss of precious life.

Graphic: via AJK Media Relations

An Indian Army infographic illustrating recent "surgical strikes" against alleged terrorist strongholds across the Line of Contact

But in general it has to be said that this was the case in the 1990s, but today Pakistan is no longer the cause of injuries and deaths along the LoC.

ESD: I know that almost every freedom fighter is automatically called a'terrorist' by the opposing or attacked side. But who

are the fighters behind Uri's attack in 2016 with 19 dead? Or the Sunjuwan attack just this year on 10 February 2018, when Jaish-e-Mohammad (JeM) fighters attacked an army camp, killing 6 Indian Army soldiers, 4 terrorists, 1 civilian and injuring 11 others. Where do these people operate from?
S.M. KHAN: Most of it is manufactured or exaggerated. As I said, there is a small local resistance and freedom movement there, but all these allegations about foreign terrorist groups invading AJK are fake news for the Western press. I strictly renounce that. I strictly deny this.

ESD: In an earlier statement on the Atlantic Council, you said that violations are not infiltrations and that attacks on these very dense and high-tech Indian LoC fortifications were impossible. Is that true?
S.M. KHAN: Yes, the other side makes contradictory statements about these "infiltrations". On the one hand, they talk about indigenous terrorists and resistance fighters in IOC supported by Pakistan. But how are they supposed to receive support? On the other hand, they are so proud of the "superfence" they have built. It's the most fortified border in the world, perhaps similar to Korea. In fact, there are two high fences with landmines in between, supported by thermal imaging cameras, motion detectors and UAVs. How can there be any significant infiltration?

ESD: Weren't there also Indian raids across the border into AJK last year? They called it…
S.M. KHAN: …yes, "surgical strikes" they called it. But these were "fake" surgical strikes, a "fake" incursion. They want to enhance their public opinion with muscle-flexing and by blowing up some houses. But when in their parliament the opposition asked for any evidence of the strike, they could not deliver one piece.

ESD: A question regarding the economy: Are there international investors in your part of Kashmir? Are international investments encouraged by your administration or Islamabad?
S.M. KHAN: Yes there are, I can name three investors. A South Korean consortium has just completed a dam for a hydropower plant and is building another one, and France is also investing in the Jagram II dam. But, of course, the strongest investor in monetary terms is China, with three hydropower plants that it is building along their China–Pakistan Economic Corridor (CPEC) initiative.

ESD: This brings us to the last issue I would have mentioned, namely the third player, China. Economically, but also militarily, the giant is Pakistan's next partner. Do they also play a role in the political Kashmir issue, perhaps as negotiators?
S.M. KHAN: China's commitment is above all economic. It should be mentioned that they were also invited by the Indians to the IOC site and are currently considering whether or not to go there. Politically, they have not made any major political announcements, but they have invited both India and Pakistan to sit down and talk to each other, either in this format or in a dialogue, because only dialogue will bring us forward.

Photo: Gandhara RFE

Indian soldiers in Srinagar in February 2018

ESD: Do you see the CPEC as an advantage for AJK, as they say officially in Pakistan?
S.M. KHAN: I believe it is of benefit to AJK, yes. It will boost our economical volume and levels.

ESD: Islamabad has been referring to the CPEC as the flagship project of China's Belt & Road Initiative and as a game changer for Pakistan's economy. However, economic experts even in Pakistan are wary that this US$60Bn megaproject will not only increase Pakistan's debt burden, but might also increase China's strategic hold in the country. Don't you think that this is not a pure "Salvation Army" approach, but that there is a strategic agenda behind it?
S.M. KHAN: Not so dramatic, please. Firstly, not all funds – exactly US$62Bn – are real loans. When the CPEC was announced in 2015 at US$46Bn, 12 of these were genuine long-term installations, which mean low interest debt for Pakistan's budget. But about US$32Bn was Chinese money, foreign direct investment in various sectors. The energy they generate is fed into the Pakistani power grid, and so on. And please, Pakistan is solvent; it would be able to pay these debts when they become due.

ESD: In fact, a recent Harvard University report has identified 16 countries that fall into the vulnerable category of what the authors call "China's debt book diplomacy." This includes Pakistan as well as countries such as Sri Lanka, Malaysia, Laos, Cambodia, and the Maldives, amongst others. So why should one be interested in exploring their Chinese Silk Road initiative?
S.M. KHAN: All the countries you are naming have officially asked or approached China to take part, to become "debtors", right? China has not put pressure on them to join this huge undertaking. Beijing has built up overcapacity and skills in technology, industrial development and human resources. Now they want to apply this to their regional neighbours and beyond. And the world is already dependent on China. For most bulk goods, from most of our cell phones to even Chinese subcomponents in the US military, from what I have read. They offer smaller nations good partnerships. Complaints about colonisation could be conceivable or partially justified for Africa. But in most cases, it's a good thing!

The interview was conducted by Georg Mader.

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The Novichoks and the Skripal Case

Implications for Chemical Defence

Dan Kaszeta

So-called " Novichoks " are an entire family of chemical warfare agents, for which the Russian word for "newcomer" is used. Until now, these warfare agents have been widely regarded as a hypothetical threat.

On 4 March 2018, in the English city of Salisbury, two Russian individuals, Sergei and Yulia Skripal, became gravely ill from exposure to nerve agents. A policeman who came to the aid of the Skripals was treated for secondary exposure to nerve agents. Some months later, two persons in the nearby town of Amesbury were hospitalised for exposure to the same material. One of them died of nerve agent exposure, making this incident into a homicide investigation.

Contingency plans are good to have, but for things like chemical terrorism, they are drawn up in the abstract without much serious case history on which to base them. Observers in this recent case can note what went right and what went wrong in order to learn from the affair. While this incident continues to evolve and only a limited amount of information is in the public domain, there are already some implications for military CBRN defence as well as those responsible for civil protection.

Novichoks Are Real

The existence of the so-called "Novichoks" (a Russian word meaning "newcomer") had been largely considered a hypothetical threat. Some people doubted their existence and the country that created them, the USSR and then Russia, has always denied the existence of the development programme, the so-called FOLIANT project, that brought them into existence. Other people have considered them to be really just a footnote of historical interest, Russia having adopted the Chemical Weapons Convention and embraced membership in the Organisation for the Prohibition of Chemical Weapons.

Author

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Photo: Peter Curbishley

A police forensics tent in front of the Maltings shopping centre in Salisbury

Officials in various intelligence agencies around the world had discussed Novichok agents since the 1990s, but other than esoteric discussions about how to detect "non-traditional agents", the Novichoks have been considered trivial and possibly only of historical interest. Their actual use in an act of chemical terrorism proves that not only did they exist, they still exist in the present day. The world now considers the insights provided by a handful of ex-Soviet scientists as useful knowledge rather than just a few old guys who had to give some information in return for their retirement in the West.

An important part of this new knowledge has been lost on many commentators: Novichoks are actually an entire family of chemical warfare agents. The one in question in the UK, allegedly the substance known as A-234, is only one of dozens of possible chemicals in this family of chemical warfare agents. It is vital to remember that most of what the mainstream defence and security community knows about this family of chemicals stems from a handful of defectors with knowledge of the overall programme and, reputedly, a single sample circulated in Europe 20 years ago. There is now additional information, albeit closely controlled by government authorities, that can be added to detection instruments.

Detection

A persistent myth, even possibly one attaining the status of "urban legend" is the allegation that western laboratories, such as the Defence Science and Technology Laboratory (DSTL) at Porton Down, cannot identify a chemical warfare agent unless they already have a sample of that substance. This sort of theory is reductionist and does not understand how modern analytical chemistry works in general and how spectroscopy works in particular.

The way modern analytical chemistry works does not require some specific sample for comparison; that way of thinking is rooted in 18th-century thinking. A competent chemist can look at the theoretical structure of a particular molecule and work out quite clearly how the spectra will appear on a gas chromatograph, mass spectrometer, or other analytical instruments. What is firmly established now is that DSTL

has good spectroscopic data on the substance used in the Skripal case, and this means that many types of detectors can be updated with new profiles.

Decontamination

An extensive decontamination effort was undertaken in and around Salisbury to ensure the safety of the general public. This effort raises a number of important points that are particularly relevant in civil protection scenarios. The first consideration is that existing technology can do effective decontamination. Novichoks are different but are not so exotic that new and different technologies and techniques are needed for decontamination. Existing technologies appear to be adequate.

Photo: OPWC

The headquarters of the Organisation for the Prohibition of Chemical Weapons (OPWC)

The next decontamination considerations are the interrelated ones of cost and time. The decontamination operations intended to make public and private property safe for occupancy have taken a long time and a very large amount of money. As of the time of the writing of this article, the effort is not complete so the overall total expenditures in time or funds are yet to be published. But civil authorities must understand that the expenses to clean up from such events are not trivial. It should be noted that, compared to the Tokyo Sarin attack (1996) and the US Anthrax Attacks (2001), the size and scope of the contamination in the Salisbury region are quite minor, yet decontamination still took weeks to conduct.

One aspect of the Novichok affair that remains a bit of a mystery is the apparent failure of the Government Decontamination Service (GDS). The GDS is the UK government's contingency plan for decontamination after CBRN incidents. A variety of environmental contractors have been put on contract by the UK government precisely to do the work needed in these scenarios. However, the first serious CBRN incident requiring decontamination since the Litvinenko polonium affair saw the apparent collapse of the GDS scheme. Contractors somehow did not perform and did not do the work. This correspondent has learned that designated contractors, under contract, cited loopholes in their contracts and did not do any decontamination. Government personnel had to be drafted in to do the actual work. This appears to be a serious breach in preparedness provisions. If the GDS did not perform as planned, the UK government needs to re-examine its civil protection provisions.

Finally, the Salisbury decontamination effort brings the perennial question of "how clean is clean enough" back into public discourse. To the layman, one obvious answer is that the necessary standard is zero molecules of the hazardous substance. However, this is an unrealistic standard and one that is completely unachievable in the field. From a philosophical and scientific vantage point, it is impossible to prove a negative. From a practical standpoint, every conceivable means of detection of chemical warfare agents has a detection threshold or limit of detection, below which the hazard cannot be detected. So, a zero-tolerance level for contamination is a standard which can never be met.

The level of contamination above zero which is acceptable, particularly in the case of persistent nerve agents that are somewhat cumulative in effect over time, is certainly open for debate. Yet nobody seems to have the answer as to how many or few molecules of Novichok can remain before something is cleared for public usage or occupancy.

This argument is very relevant to military decontamination, as the same intellectual problem occurs with contamination of military equipment. The issue of how clean a tank must be after a chemical warfare attack before it is returned to service is, fundamentally, the same as how clean a piece of pavement in Salisbury must be before the public are allowed to walk on it. Yet there is no convincing answer. This is clearly an area where more work is needed.

Forensics

Crimes involving CBRN materials are rare. However, readers of this publication and members of the public at large are mistaken if they do not understand that CBRN forensics is a legitimate and separate specialised discipline still in its infancy. There is a worldwide need to have the ability to conduct specialty forensic science in the event of an incident involving CBRN materials.

The ability to do this science in a way that would survive adversarial scrutiny in a judicial proceeding is lacking in many parts of the world. The UK, like the US, is well ahead of much of the rest of the world. However, the question arises whether, if this incident were to happen in, say, Belgium or Brazil, would there be the capability to collect and process highly dangerous chemical warfare forensic materials? In many parts of the world, the ability to actually pursue a prosecution of a chemical warfare agent incident under acceptable principles of jurisprudence is questionable.

A fundamental paradox has appeared, one that has been long forecasted and has now come to life, based on this correspondent's own discussions with criminal defence lawyers. The fate of a criminal investigation may very well rely upon chemical warfare agent forensics. However, vital aspects of a criminal investigation are likely to rely upon conventional evidence such as fingerprints, electronic exploitation (such as data on a smartphone) and similar forensics.

In many places the laboratory that can process the chemical warfare agent material cannot exploit the conventional evidence, and the conventional criminology laboratories often cannot handle evidence that is contaminated with chemical warfare agents. The UK legal system will likely have an inquest for the Amesbury victim, and it will be interesting to see what evidence is presented and how this is done. Likewise, if there is ever a criminal trial, much will be learned about the interaction between chemical warfare forensics and the English legal system.

Photo: via Author

The poisoning of the Skripals with a previously unknown neurotoxin has alarmed the CBRN expert community.

Medical Countermeasures

The fact that five people have been exposed to a highly toxic Novichok agent, and four of the five have survived is an important point. It points out that Novichoks, while being new and different in some ways, perform the same way on a biochemical basis as all of the older nerve agents. They interfere with the chemistry of the human nervous system by binding with the enzyme acetylcholinesterase, which in turn causes a lot of problems throughout the body. But in this regard, the Novichoks are much the same as the original nerve agent Tabun.

Existing clinical treatment protocols for nerve agent exposure clearly do save lives, even though one of the victims did die. The proven record at Salisbury District Hospital now shows that the same medical protocols for other nerve agents are equally applicable to exposure to so-called Novichok agents. Although it will take some time for peer review, one can expect interesting journal articles to be published on the basis of the knowledge gained in the Salisbury affair.

The drug atropine, a generic pharmaceutical derived originally from the belladonna plant, has long been the mainstay of nerve agent treatment. In the Salisbury incidents, the administration of atropine appeared to save several lives. Oxime drugs, which also form a valuable part of the medical countermeasures against nerve agent exposure, were similarly helpful, although to what extent remains unpublished. Existing nerve agent antidote kits stockpiled and fielded for military use bundle atropine and an oxime, and this concept is validated. Indeed, the idea to stockpile nerve agent antidotes for both military and civil contingencies is given more validity now that it can be demonstrated that these work in practice as well as in theory.

Protection

While there has been no small degree of hyperbole and panic associated with the Novichok case in the UK, one small detail goes largely unnoticed by the general press. All five cases have been contact hazards absorbed through the skin, primarily if not entirely, through the hands. The idea that Novichoks are some sort of exotic hazard requiring new types of CBRN protection has never been put forward by serious experts in the field and has now been validated by practical experience on the ground.

It turns out that the most important thing that anyone can do to protect themselves from this particular example of Novichoks is to wear gloves. In fact, nearly any glove will do. Impermeable latex, butyl, or nitrile gloves are probably better for resistance, but any glove will provide a degree of protection.

The volatility (propensity to go from the liquid to the vapour state) of this particular Novichok appears to be low. It is a liquid, not a gas or vapour. So, the principal method for protection is a pair of inexpensive gloves. It is important to keep this in perspective. Gloves, and the concomitant discipline to not touch things unnecessarily once the gloves are potentially contaminated, are the important things to remember with Novichoks.

Arms Control and Non-Proliferation

An important aspect of the Novichok case is that it raises serious questions about arms control, non-proliferation, and diplomacy. In an era where developing new nerve agents is strictly prohibited by treaty, there is now clear evidence that somebody, somewhere, quite possibly the Russian state, is in breach of both international arms control agreements and the norms of conduct between states.

The legal standing of the Novichok chemicals with regards to the Chemical Weapons Convention (CWC) is an interesting point, relevant to international law. The substance allegedly used, "A-234", is not listed in any of the schedules of the CWC, which list specific substances of proliferation concern. It seems obvious to many that the CWC schedules will need some revision, as they were written and agreed upon at a point in history where the Novichoks were not known. Indeed, the fact that A-234 is not a scheduled chemical might have been a reason why contractors were able to refuse to perform decontamination tasks.

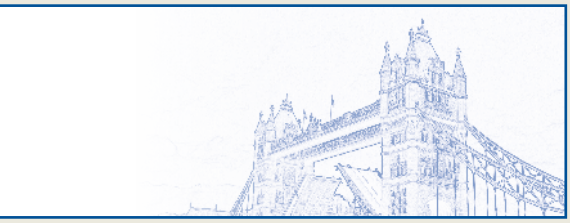
The struggle for those concerned with arms control and proliferation issues will be to keep others from making Novichoks. There is real concern in this area, and this is one of the key reasons the UK government has continued to insist that the full OPCW report into the Skripal samples not be published, thus implying that this report has information of proliferation concern contained within it.

Photo: US Army

At the UK Defence Science and Technology Laboratory, known as DSTL, a US Army chemist works with the Porton Man, a contaminated mannequin dressed in full protective gear. At DSTL, chemical-protection experts can enter a laboratory to get a first-hand look at chemical-protective ensembles, which enables system-level research and testing.

Conclusion

The Novichok affair is still an ongoing investigation and various aspects of it may continue for some years. Further information will, of course, be released or leak out into the public domain. However, there is a useful set of lessons that can already be learned. ■



Viewpoint from London

The British Modernising Defence Programme

Conrad Waters

The United Kingdom's 2015 Strategic Defence & Security Review (SDSR 2015) was broadly positively received in making good some of the larger capability gaps created by previous defence cutbacks. However, the strategy soon began to unwind due to overly-optimistic financial assumptions, exacerbated by the headwinds of Brexit. In January 2018 new Defence Secretary Gavin Williamson announced the Modernising Defence Programme, a mid-cycle defence review aimed at squaring the circle. The review is struggling to reach tangible conclusions in the face of ongoing budgetary constraints and uncertainty over the extent of the United Kingdom's future military ambition.

Background

The United Kingdom's SDSR 2015 seemingly drew a line under a period of military cutbacks driven by the age of austerity. Supported by a commitment to a modest rise in defence spending, the review heralded a significant boost in equipment spending and an expanded 'Joint Force 2025' vision that filled some of the armed services' previous capability gaps. Joint Force 2025 envisaged the ability to deploy up to 50,000 personnel – including a maritime task group centred on a QUEEN ELIZABETH class aircraft carrier; a land division of three brigades; and an air group of combat, transport and surveillance aircraft – in an expeditionary operation. Renewal of the strategic submarine fleet would ensure conventional forces would continue to be backed by the TRIDENT missile-based nuclear deterrent.

Unfortunately, it quickly became clear that SDSR 2015 had made more commitments than the small uplift in defence spending allowed. A particular area of pressure related to the forward equipment budget, which was projected to amount to nearly £180Bn (€200Bn) over a ten year period. The plan did not include the full cost of all the equipment scheduled to be procured; relied on efficiency savings that might not be achievable; and has subsequently proved vulnerable to the depreciation of sterling following the 2016 Brexit decision. In January 2018, the National Audit Office – Britain's budget watchdog – concluded that 'The Defence Equipment Plan is not affordable'. It estimated a shortfall of between £4.9Bn and £20.8Bn over the plan's life.

In the meantime, the British government had initiated its own interim review of national security, the National Security Capability Review (NSCR), after the 2017 general election. Intended to be a fiscally-neutral re-examination of security priorities against the backdrop of a fast-changing international environment, NSCR soon became ensnared in the structural hole facing the Ministry of Defence's budget. Faced with unpalatable options for significant reductions in the armed forces – the abandonment of the navy's amphibious shipping was reportedly one mooted option – it was determined that future decisions on defence ministry capabilities would be spun off from those of the other security services. On 25 January 2018, recently appointed Defence Secretary Gavin Williamson announced a Modernising Defence Programme '…to deliver better military capability and value for money in a sustainable and affordable way.'

Photo: Crown Copyright 2017

A British Army FOXHOUND patrol vehicle providing security to an Afghan National Army officer graduation ceremony. Financial constraints are leading to questions over the extent of the British Armed Forces' global role.

The Modernising Defence Programme

The decision to consider defence ministry requirements separately from those of the United Kingdom's broader security infrastructure received an initially positive response. It provided a breathing space to take a more detailed look at defence priorities without delaying the broader NSCR process. It also opened up the prospect of additional resources being made available to close the ministry's funding gap outside the constraints of the NSCR's fiscal neutrality. At the same time, there was some concern it was largely being used as a device to postpone difficult choices. These fears have grown as the Modernising Defence Programme's timeline has steadily extended.

The Modernising Defence Programme's mid-cycle review has essentially faced three major difficulties. Of these, the most significant has probably been the question of money. Although the United Kingdom's public finances are on an improving trajectory, the uncertainty over Brexit means there is more than the usual level of Treasury reluctance to make new spending commitments. The spending squeeze has been exacerbated by the high priority accorded to the National Health Service. In June 2018 it was announced healthcare would receive a c. £20Bn p.a. funding boost, leaving little spare cash available for other departments.

There has also been a more fundamental debate over the level of military ambition that post-Brexit Britain should aim to sustain. Rather simplistically, this has been condensed into a discussion as to whether the United Kingdom should aim to be a 'tier one' military power with an independent ability to deploy warfighting forces on a global basis. In June 2018, a widely-cited report by the respected Financial Times newspaper suggested British premier Teresa May had asked Defence Secretary Williamson to justify the continuation of this ambition. Another aspect of this debate is the extent to which new areas of warfare, for example in the cyber domain, should be prioritised over more traditional military capabilities.

Inevitably, the mid-cycle defence review process has also become caught-up in the fraught negotiations surrounding the terms of the United Kingdom's departure from the European Union. The strains inherent in trying to steer a minority and bitterly divided government through the Brexit process has meant that there has been little 'bandwidth' available for other considerations, even those of national security. This has hindered a clear decision being taken on the defence sector's future.

The Current Position

The current impasse was reflected in the first significant update on the review provided to members of parliament in July 2018, just before the long summer holidays. Full of platitudes but short of hard facts, the update headlined three overarching but rather intangible conclusions, namely:

1. The armed forces needed to be able to match the increasing pace at which adversaries now move.
2. The force structure needed to be modernised to meet the challenges of the 21st century.
3. The defence ministry needed to adapt to deliver credible but affordable armed forces

Photo: Crown Copyright 2004

The amphibious transport dock HMS ALBION participating in a NATO exercise in Norway. Britain's amphibious capability is one area reported to have been under consideration for deletion.

Perhaps more interestingly, the statement affirmed the key design principles of Joint Force 2025, suggesting a desire to retain a global UK military capability in spite of the questions over 'tier one' status. This was reinforced by a commitment to maintain a full spectrum of nuclear, conventional and cyber capabilities in line with the United Kingdom's global ambitions. However, there was little clarity how an ambition to accelerate elements of the planned force structure to meet the most acute threats would be achieved. Another interesting element was the focus on a collaborative yet challenging approach to industry, seemingly building on the tenets of the 2017 National Shipbuilding Strategy and the subsequent Combat Air Strategy published in July 2018. Whilst these initiatives may well yield benefits in the long-term, they are likely to be a further drain on resources in the immediate future.

The update promised further information would be forthcoming as the next phase of the Modernising Defence Programme was progressed. However, no clear timeline was provided as to when decisions might be reached. It is notable that the review process has already exceeded the time required for the last two, full scale SDSRs. This is, perhaps, the clearest indication of the major difficulties faced by the defence secretary in squaring the funding circle. Although it would seem likely that some additional money will eventually be found for defence, it is questionable whether this will be sufficient to achieve more than the postponement of some of the harder decisions.

Conclusion

The hesitant progress achieved with the Modernising Defence Programme is reflective of some of the wider challenges the United Kingdom faces as it prepares to leave the European Union. Considerable uncertainty over the country's future economic prospects are leading to fundamental questions arising on the practicality of its global military ambitions at a time when dangers closer to home are increasing. In broader terms, the question is whether the United Kingdom's government is willing and able to fund the 'Global Britain' vision that is a key part of the Brexit narrative. At this moment in time, the answer to this question is uncertain.

The RAF's Counter-Daesh Operation SHADER

Joetey Attariwala

Royal Air Force Base Akrotiri is situated on a peninsula in the south of Cyprus. Its position in the eastern Mediterranean is of immense strategic importance as it is in close proximity to the areas in Iraq and Syria where Daesh and other terrorist elements declared the establishment of a caliphate in 2014.

The base is home of the Cyprus Operations Support Unit which provides joint support to British Forces Cyprus and operations in the region to protect the UK's strategic interests. RAF Akrotiri is a busy permanent joint operating base that supports ongoing operations in the region as well as support for the sovereign base areas on Cyprus. It is used as a forward mounting base for overseas operations in the Middle East and for fast jet training.

Photos: Joetey Attariwala

RAF TYPHOONs return to RAF Base Akrotiri from an Op SHADER mission.

RAF Akrotiri is also home to the RAF's 903 Expeditionary Air Wing (EAW) which is tasked with conducting combat operations to prosecute Daesh / the Islamic State. The base also has 84 Squadron as a tenant with its HAR.Mk 2 GRIFFIN helicopters; the squadron serves an important search and rescue function in collaboration with the Republic of Cyprus Police and National Guard Air Command.

Operation SHADER was established in 2015 and is the name assigned by the British Ministry of Defence for the UK's counter-Daesh operations in Iraq and Syria. Numerous bases contribute to Op SHADER, and key among them is RAF Akrotiri. It is here where the Royal Air Force deploys fast jet combat aircraft to deliver kinetic effect against Daesh. The primary aircraft which deliver these effects are RAF TORNADO GR4's and the newer multi-role Eurofighter TYPHOON. RAF REAPER UAVs also deliver kinetic effects; however these aircraft are not operated from RAF Akrotiri.

Author

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The Aircraft of the 903 EAW

The UK's 83 Expeditionary Air Group (EAG) supports the UK's Permanent Joint Headquarters with a number deployable expeditionary air wings that assist in enabling force packages as required. The 83 EAG command headquarters is currently based at Al Udeid Air Base in Qatar. Over 1,000 personnel are attached to the 83 EAG, with these personnel spread across the Middle East and the Mediterranean.

The UK's 83 EAG feeds into a larger coalition effort which consists of 77 nations, of which air operations are managed by the Combined Air Operations Centre (CAOC), which is also situated at Al Udeid Air Base. The CAOC is the focal point which generates air tasking orders for each of the nations contributing to the air campaign. Of these, the Royal Air Force has the distinction of being the second largest contributor to the air campaign, and it provides niche capabilities in Intelligence, Surveillance, and Reconnaissance (ISR), and air-refuelling assets.

In the case of RAF Akrotiri, it is the 903 EAW which is resident on base and carries out its mission on direction from the 83 EAG and the CAOC. Aircraft allocated to the 903 EAW include TORNADO and TYPHOON fighters, the VOYAGER air-to-air refuelling tanker and transport aircraft, and the SENTINEL R1 which provides long-range, wide-area battlefield surveillance, delivering critical intelligence and target tracking information to British and coalition forces. Approximately 500 personnel are attached to the 903 EAW at RAF Akrotiri; these individuals fly, maintain and support the wing's aircraft, and depending on position are on rotational tours of three, four or six months. Supporting the 903 EAW are tactical and strategic aircraft consisting of the RAF's C-130J SUPER HERCULES, A400M ATLAS, and C-17 GLOBEMASTER III airlifters.

Speaking about RAF Akrotiri was Wing Commander John Eklund, RAF Media Ops, who said, "RAF Akrotiri is very much the heartbeat of the UK's contribution to the multi-national coalition operations which is successfully defeating Daesh in Syria and Iraq. Each day you see

TYPHOON and TORNADO take off from here, supported by VOYAGER. Elsewhere we've got ISTAR assets and REAPER who are all taking the fight to the opposition."

Locating the Enemy

According to Group Captain Chaz Dickens, Commanding Officer of 903 EAW, the biggest challenge is "finding the enemy." A key asset which he employs to locate enemy forces is the SENTINEL aircraft. "That aeroplane will go out, it will search an area around 50 square miles at a time, and they're looking to establish a pattern of life - what is going on on the ground - so that we can build up over time an intelligence picture of where the friendly forces are, but also more importantly, where are people going and why are they going there," said Dickens. "Once we have an understanding of the pattern of life, and that will involve communications with our partner forces on the ground, we will use our assets like the REAPER or the fast jets to then build upon that picture using advanced targeting pods like the LIGHTNING pod or the REAPER sensors. We'll start to look at the areas that we've seen a change in the pattern of life and to try and develop that understanding so we can find and then target the enemy should they present themselves."

According to the RAF, in June 2017 the majority of Daesh fighters were located in the Middle Euphrates River Valley, also known as MERV. Since then, coalition forces have "cleaned out" the majority of Daesh in that area, and much of the effort in recent months has been centred on the Dashisha area. The final focus area is a small remaining zone of contested space around the Mid-Euphrates River Valley.

According to Dickens, the coalition has pushed Daesh out of 98% of the area they once occupied. "Compared to the intense fighting around Mosul, the kinetic activity has reduced, but over the campaign the Royal Air Force has employed over 1,700 separate strikes… The tempo of the campaign is reducing as we squeeze and degrade Daesh down into the MERV area," said Dickens.

Flying over Syria and Iraq

Once the enemy's location is established, the 903 EAW employs combat air power to neutralise threats. In the case of RAF Akrotiri, this falls to the TORNADO and TYPHOON aircraft which are forward deployed to the base. The 903 EAW typically has eight TORNADOs assigned to it, and six TYPHOONs which are assigned in the attack role.

"This is the point about air power - we can go anywhere across the country, wherever the Daesh fighters come together, be that in Iraq or across Syria," said Dickens. "Our main focus is clearly on clearing the last elements of Daesh out of Syria, but we are still providing security and overwatch of Iraq, and when needed we are still doing strikes in Iraq whenever Daesh mass."

"Syria is one of the most complicated air campaigns I've ever been involved in," said Dickens. "Clearly, the Syrian regime has surface-to-air missiles; the Russian forces are also present and they've brought some of their own weapon systems in terms of advanced fighters as well as surface-to-air missiles. My main concern, because we deconflict our activity with the Russians, is Daesh's ability to use small arms, heavy machine guns, and man-portable air defence systems - so surface-to-air missiles - against my aircraft… There have been surface-to-air firings against my aircraft, and we will adapt our tactics, techniques and procedures based on the threats that are presented to us."

A VOYAGER tanker returns to Akrotiri after an Op SHADER support mission.

Op SHADER fast jet combat missions are often preceded by the launch of a VOYAGER air refuelling tanker which will take up position to top-up the TORNADO and TYPHOON aircraft as they approach their operating area. Transit time into Syria after mid-air refuelling is approximately one hour, with missions typically lasting six to eight hours, and often requiring multiple air refuelling evolutions.

Missions from RAF Akrotiri typically consist of two TORNADOs and two TYPHOONs launching in one wave, followed by another similar wave later in the day. According to Dickens, the current bomb of choice for the RAF is the PAVEWAY IV dual-mode guided bomb. Both aircraft use the PAVEWAY IV, while the TORNADO also employs the BRIMSTONE missile - the latter capability will migrate to the TYPHOON towards the end of this year.

Aircraft operating from RAF Akrotiri are almost immediately in the range of Russian S400 missile batteries (NATO reporting name: SA-21 GROWLER) which are deployed in Syria. This fact is not lost on RAF pilots who are constantly aware of that potential threat. The RAF, like other Coalition partners, seek to deconflict their flights through a direct line with Russian air controllers.

TYPHOON in the RAF´s Counter-Daesh Operations

The Royal Air Force will have seven TYPHOON squadrons by 2019, and eight squadrons once a joint RAF/Qatari squadron is commissioned in 2020.

For Op SHADER, the RAF currently operates TORNADO and TYPHOON fast jet fighters, however the former will be retired in 2019, leaving the TYPHOON as the primary multi-role fighter aircraft prosecuting the fight.

Tranche 2 and 3 TYPHOON Phase 1 Enhancement (P1E) fighters have been used in Op SHADER, all of which will be upgraded under the UK's Project CENTURION weapons fit upgrade programme. This upgrade, which includes aspects of Phase 2 and Phase 3 Enhancement (P2E / P3E), will allow the TYPHOON to employ the METEOR beyond visual range air-to-air missile, the BRIMSTONE air-to-ground missile, and the STORM SHADOW cruise missile. A Mode 5 Identification Friend or Foe (IFF) interrogator upgrade is also imminent.

The operational payload fit for Op SHADER missions which the TYPHOONs are currently flying have a focus on air-to-ground capability. Each mission dictates the payload fit, which could include Advanced Medium Range Air-to-Air Missiles (AMRAAM), Advanced Short Range Air-to-Air Missiles (ASRAAM), PAVEWAY IV bombs, a LITENING III targeting pod, and external fuel tanks. The TYPHOON is also fitted with a MAUSER 27mm cannon.

RAF crews prepare a TORNADO GR4 for an Op SHADER missions.

The main sensor for the TYPHOON is its ECR-90 CAPTOR radar (also known as the CAPTOR-M). The aircraft also employs the Passive Infra-Red Airborne Track Equipment (PIRATE) system, which provides Infrared Search and Track (IRST) capability - a system which is particularly useful in identifying low-observable aircraft.

The TYPHOON Detachment Commander at RAF Akrotiri (name being withheld for security reasons) explained how the TYPHOON is perfectly suited to its mission particularly due to its sensor fusion capability between the radar, the PIRATE system, and Link 16.

The modern glass cockpit has three large multi-function displays, and a wide-angle Head-Up Display (HUD). "One of our biggest threats, beyond surface-to-air missiles and anything like that, is actually other aircraft. Because Daesh has been shrunk down to a very small area, there is now a serious concentration of aircraft - RPAS and manned ISR and attack platforms, etcetera, all in quite a small piece of space. The radar is key, particularly coming off refuelling and getting back into your airspace," explained the TYPHOON Detachment Commander. "We're not built for ISR per se, but I'd say we're a non-dedicated ISR platform. The targeting pod gives us a great capability. We work with JTACS who routinely task us to build on that broader pattern of life as the CO described. We're trying to find specific intelligence on individuals, groups, networks, to build that picture, that's our primary job most of our time here."

The TYPHOON is fitted with wingtip electronic support measures (ESM) and towed decoys. The TYPHOON also has the fully integrated Praetorian Defensive Aid SubSystem (DASS) which provides threat assessment, aircraft protection and support measures in extremely hostile environments. Speaking to this capability, the TYPHOON Detachment Commander said, "The DASS display is a key capability for the aircraft. It is a definite strength and it gives great awareness of who's around, who's looking at me, and who might be a threat… The only thing that isn't fused in the jet at the moment is the DASS. But, because the DASS is so good and it's so well presented to you, I personally don't find that a problem."

Pilots flying the TYPHOON wear a Helmet Mounted Sight which allows for automatic sensor cueing. "It allows me to see where my sensors are looking on the ground. JTACs can ask us to look at several things, so all we need to do is type them into the system so you can rapidly bring the sensors to bear to look in that direction. Likewise, if I see something of interest on the ground, like an explosion, I can rapidly move the sensors to it in a matter of seconds. That way I can have a targeting pod on it, and I can see the big picture with the helmet," explained the TYPHOON Det Commander. "By night we'll use a night helmet with NVGs. The next generation helmet we're hoping to get will have an integrated night vision camera."

"Performance wise, from a pilot's perspective, the TYPHOON is a great aircraft to fly. With 40,000 pounds of thrust available there's no need to use reheat to get airborne, even with the SHADER fit. It's carefree handling," shared the TYPHOON pilot.

Interestingly, the maintenance crews at RAF Akrotiri were keen to point out that they only keep one spare TYPHOON engine on hand due to the high reliability of the TYPHOON's Eurojet EJ200 engines. "The engines are very reliable and it's not a difficult thing to do to change one. All in, to change an engine and have it tested and signed off would take about 5 hours," explained a RAF maintenance technician.

Advantages of the TYPHOON

Speaking about the advantages of the TYPHOON, the Detachment Commander shared the following: "This is a great airplane. You have a big delta wing, highly manoeuvrable aircraft. This airplane is a 9 G airplane, and that's 9 G's sustained. It has carefree handling, excellent engines with a spectacular amount of thrust. You can fly very high, and very fast. It's a great capability and it's only going to get better with the CENTURION enhancements. The dual-mode PAVEWAY IV is already a great capability and is highly flexible as its GPS mode allows the TYPHOON to strike four separate targets simultaneously. We can generate our own coordinates by using the laser from the pod, and the advantage of the coordinate seeking mode of the weapon is it is wind corrected. You'll also have the edge in a long range missile fight because you are higher and faster than other fighters. If you are through the mach, launching long range missiles, you are already helping them on their way because of how fast you are going and how high you are. Then if you go into the visual arena, you have got so much thrust available to you, that you can fight the fight you want to fight, and win."

Coalition Air Campaign Delivering Success

According to a Coalition estimate, the air campaign has killed 50,000 Daesh fighters. "Daesh has been severely degraded over the last four years, but they are not yet defeated. It will not be long before we have destroyed the physical caliphate where they hold land on the ground, but we now need to defeat them as an organisation," said Dickens. "We need to disrupt their networks, we need to disrupt their abilities to resupply - that will take time. So in the future, although they don't hold land, we need to stop them becoming an insurgency and we need to stop them to have the ability to mass… The Coalition will need to stay together to be able to target Daesh wherever they come to target and produce insecurity." ■

Portugal´s Naval Commitment

Conrad Waters

One of Europe's oldest fleets, the Portuguese Navy – Marinha Portuguesa – has a history that is inextricably linked to Portugal's past as a global colonial power.

Portugal is a relatively small European economy with large maritime interests. The Portuguese Navy has essentially adopted a two-tier structure to meet its responsibilities. Under this structure, a small force of frontline combatants is supported by larger numbers of constabulary vessels. Although the navy has faced considerable financial headwinds in recent years, it is making good progress completing a major programme of fleet renewal.

Background

Although the colonial era ended in 1975, the retention of the autonomous regions of the Azores and Madeira within the Portuguese Republic has meant that considerable maritime interests remain. Portugal's exclusive economic zone (EEZ) of over 1.7 million km² is the fourth largest in the European Union. The area of the country's maritime interests will more than double if a proposal to extend Portugal's continental shelf under the terms of the United Nations Convention on the Law of the Sea (UNCLOS) is ultimately approved.

In European terms, Portugal has a relatively small economy from which to fund its considerable naval requirements. Moreover, the legacy of the Eurozone crisis means that defence budgets have been under pressure in recent years. According to NATO data, Portuguese defence spending fell from €2.6Bn to an estimated €2.4Bn in cash terms between 2011 and 2017. This represented a decline from 1.5% to 1.2% of GDP. A more stable economic outlook and continued NATO pressure on its members to meet the agreed 2% of GDP guideline for military spending suggests a somewhat more positive budgetary backdrop in the years ahead.

Author

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Portugal is currently preparing for its next four-year military planning cycle, which commences in 2019. This should provide further clarity on the likely trajectory of defence spending and military priorities. One outcome of the process will be an updated military programming law, which will set out planned procurement expenditure over the next twelve years. The navy was allocated around a third of total investment under the current 2015-2026 law. Maritime requirements have typically been accorded a high priority in Portuguese defence funding given the geographical factors outlined above. There are indications the navy will continue to fare well when the new allocations are determined.

Although now somewhat dated, the 'Defence 2020' reforms approved in 2013 probably remain the most influential factor – at least in the public domain – determining the Portuguese Navy's priorities and structure. These essentially mandated a military capable of supporting:

- An Immediate Action Force providing an autonomous means of evacuating citizens from areas of crisis and allowing a national response to other emergencies;
- Permanent Sovereignty Forces providing a range of surveillance and response capabilities to safeguard Portugal's national territory;
- Modular International Forces to deploy the military in support of Portugal's collective and international defence responsibilities.

The structure reflected the low likelihood of a state-based threat to Portugal's territorial integrity but the increasing risk posed by terrorists and other non-state actors in the post-Cold War environment. The vulnerability of the Portugal-Azores-Madeira triangle to any spillover of unrest in potentially unstable African nations was a significant consideration. The structure also manifested Portugal's continued reliance on collective defence engagement to secure its wider interests.

Although the Chief of the General Staff and the Portuguese Navy have both recently published new strategic documents, a politically-driven defence review to take account of the changing international security environment is probably overdue.

Foto: Crown Copyright 2018

The Portuguese Navy has to fulfil considerable maritime security commitments. This image shows its sole replenishment tanker BÉRRIO in company with the MEKO 200 (PN) type frigate ÁLVARES CABRAL in 2018.

Current Fleet Structure

The Portuguese Navy has essentially adopted a two-tier structure to meet the country's considerable maritime security commitments. This has involved maintaining a small flotilla of sophisticated surface combatants and submarines capable of higher-intensity warfighting. These vessels are supplemented by a larger force of simpler and cheaper patrol vessels suitable for constabulary operations across the vast waters of the country's EEZ. Whilst this structure predates the 'Defence 2020' reforms, it is well-suited to the strategy's requirements. In simplistic terms, the frontline warships provide the units needed for the Immediate Action and Modular International force elements. This leaves the more numerous fleet of patrol vessels to provide the surveillance and response roles demanded of the Permanent Sovereignty requirement.
The Portuguese Navy's most important constituents are listed in the Table and can be summarised as follows:

Submarines: The two Type 209 (PN) TRIDENTE class submarines delivered from ThyssenKrupp Marine System's HDW yard at Kiel are probably the Portuguese Navy's most potent assets. They are effectively variants of the Type 214 air independent propulsion-equipped design and were commissioned in 2010. Displacing around 2,000 tonnes in submerged condition, they are equipped with eight 533mm torpedo tubes for up to sixteen WASS BLACK SHARK heavyweight torpedoes.

Surface Combatants: The surface combatant force comprises three MEKO 200 (PN) VASCO DA GAMA class and two 'M' or BARTOLOMEU DIAS class frigates. The former types were newly-built in Germany with funding assistance from NATO and commissioned in 1991. The two 'M' class vessels originally served with the Royal Netherlands Navy and were acquired under a deal announced in 2006. Originally completed in 1994, they recommissioned in 2009 and 2010. All five frigates are general-purpose vessels with armament that includes HARPOON surface-to-surface and SEA SPARROW surface-to-air missiles. They also have the capability to embark a SUPER LYNX helicopter.

Patrol Vessels: Until recently, the force of constabulary patrol vessels was largely a legacy of the colonial era, being mainly comprised of early 1970s-era JOÃO COUTINHO and BAPTISTA DE ANDRADE 'colonial corvettes' re-rolled as offshore patrol ships and CACINE class coastal patrol vessels. These

Foto: US Navy

Collective security arrangements form an important part of Portugal's defence strategy. Here the 'M' class frigate BARTOLOMEU DIAS is seen exercising with allied navies in 2010.

elderly ships are costly to operate in terms of both crewing and maintenance requirements, but their replacement was delayed as a consequence of the European financial crisis. However, new ships are now starting to enter service, as further described below. As a result, only a handful of the legacy vessels now remain in service.
The Portuguese Navy also operates a number of small patrol boats to perform coast guard and training functions. These are supplemented by four sail training vessels of various sizes in the latter role. Of greater significance are the navy's two oceanic and two coastal survey vessels, as well as the sole replenishment tanker BÉRRIO.
Logistical and administrative support for the fleet remains focused on the Lisbon Naval Base, which includes the maintenance and refit capabilities of the Alfeite Arsenal. Minor support facilities are located elsewhere in Continental Portugal and in the autonomous islands. Another facility with considerable naval significance is the private West Sea Viana Shipyard (formerly ENVC) north of Porto. This is the country's main facility for the construction of new warships of oceanic size.

Recent Challenges

The Portuguese Navy was fortunate that funding for renewal of its frontline combatant force was largely committed when the Eurozone's financial crisis broke. This ensured the survival of an effective force of frigates and submarines during the years of austerity that followed. Although the stage has now been reached where the frigate force requires significant mid-life modernisation, the core of the fleet remains in relatively good shape.
The remaining picture is somewhat more mixed. The programme that was underway to modernise the combatant force was accompanied by an additional project focused on wholesale renewal of the constabulary fleet. The project was entrusted to the then ENVC shipyard at Viana do Castelo and envisaged the construction of a series of NPO2000 offshore patrol ships in at least two configurations to replace the existing corvettes. These would be supplemented by a new class of smaller coastal patrol vessels to allow retirement of the CACINE class. The first two offshore patrol vessels – the VIANA DO CASTELO class –

Foto: TKMS

The Portuguese Navy's two AIP-equipped TRIDENTE class submarines are probably its most potent units.

were ordered in 2002. However, the project proved to be beyond the capabilities of the shipyard to deliver in a timely and efficient fashion, with the pair being delivered several years behind schedule.
The consequences of these problems were significant. The remainder of the new patrol vessel programme was eventually suspended – possibly influenced by the financial environment – and ENVC collapsed. This was reflected in the retention of the remaining colonial corvettes and patrol vessels well beyond their original service lives. A plan to acquire a bespoke amphibious capability, a programme that would also have been entrusted to ENVC, was also abandoned. More positively, the two initial VIANA DO CASTELO class vessels have proved successful in service. With the financial backdrop now considerably more stable, a way has been found to resurrect the project.
Another consequence of the age of austerity has been difficulty in recruiting and retaining sufficient personnel, a problem by no means restricted to the Portuguese Navy. The navy entered the current decade with around 10,500 personnel, including 1,500 Marines. Subsequent defence reductions, including the 'Defence 2020' reforms, have reduced required headcount to a little under 9,000 but there have been reports the navy is struggling even to fill this reduced number of billets. The retention of elderly ships with heavy manning requirements and outdated accommodation standards are even more of a problem in these circumstances.

Major Programmes: Current Status

Current naval procurement objectives are dominated by the need to complete the previously suspended renewal of the constabulary fleet whilst embarking on mid-life modernisation of its major surface combatants. At present, it seems that good progress is being made with achieving both aims.
The patrol vessel replacement programme now has two strands. The resurrection of ENVC as the West Sea Viana Shipyard has provided the opportunity to restart construction of VIANA DO CASTELO class offshore patrol vessels. Two further members of the class – SINES and SÉTUBAL – were ordered in mid-2015, with construction progressing far more smoothly than with the initial pair. SINES was delivered in July 2018 and her sister is expected around the end of the year. Displacing around 1,850 tonnes, the vessels are lightly armed but incorporate a helicopter platform and an efficient combined diesel or electric (CODOE) propulsion system. They have a complement of around 40, little more than half the number required to operate the ships they are replacing.

Foto: US Navy

The MEKO 200 (PN) type frigate CORTE-REAL pictured in November 2017. The three MEKO 200 VASCO DA GAMA class frigates are an important component of Portugal's small force of surface combatants.

The success of the restarted construction programme was reflected in an announcement by Portuguese premier António Costa at SINES' commissioning ceremony that the offshore patrol vessel programme would be expanded to a total of ten units, with the additional six to be funded in the next military programming law. Each ship is expected to cost €60M and take around two years to complete. In effect, the announcement means that replacement of the old corvettes will now take place on a one-for-one basis.
The other element of the renewal of the constabulary fleet has involved the acquisition of five decommissioned Danish StanFlex 300 FLYVEFISKEN class vessels to replace the CACINE class in the coastal patrol role. It was originally intended that four of the ships would be refurbished and converted at the Alfeite Arsenal under a programme initially costed at €28M, with the modernised vessels being delivered on a roughly annual basis from 2016 onwards. The fifth was to be held as a source of spares. However, the condition of the ships has proved sufficiently good that all five will now enter operational service.
The prime ministerial announcement of additional offshore patrol vessels was accompanied by a commitment to acquire a new multipurpose logistic support ship. This will also be allocated to the West Sea Viana yard. Few details of the new vessel have emerged to date, but there is a pressing need to replace the single-hulled tanker BÉRRIO. She originally entered service as the British Royal Fleet Auxiliary service's BLUE ROVER as long ago as 1970. However, the Portuguese Navy still have ambitions to resurrect the plans for an amphibious capability that were abandoned during the period of austerity and it is possible that a hybrid unit along the lines of the Dutch joint support ship KAREL DOORMAN is contemplated. It will be interesting to see how far a budget likely to amount to c. €150M stretches.
Meanwhile, plans for midlife upgrades of the fleet's major surface combatants are also moving forward. These also involve a twin-track approach. The two BARTOLOMEU DIAS class frigates are to receive a comprehensive upgrade package to allow them to remain suitable for deployment on high-intensity operations. Pragmatically,

Foto: Portuguese Navy

The lead VIANA DO CASTELO class offshore patrol vessel was delivered at the end of 2010. Construction of the two lead vessels was considerably delayed, leading to postponement of the overall OPV programme.

Foto: Author

The 'M' class frigate BARTOLOMEU DIAS pictured on her delivery voyage from the Netherlands to Lisbon. She has now returned to Den Helder to undergo a mid-life modernisation.

Foto: West Sea Viana Shipyard

The second VIANA DO CASTELO class offshore patrol vessel FIGUEIRA DA FOZ in dock at the West Sea Viana Shipyard. The resurrection of the former ENVC yard under new management provides the Portuguese Navy with an important shipbuilding asset.

this work has been assigned to the Netherlands, where broadly similar updates of the Dutch and Belgian members of the class have already been completed. Key elements of the Portuguese modernisation package will include new combat management and electronic warfare systems, as well as the replacement of the Sea Sparrow missile with ESSM. Work on BARTOLOMEU DIAS commenced at Den Helder in mid-2018 and will take around 18 months to complete. She will then be followed by her sister D. FRANCISCO DE ALMEIDA to allow the programme to be completed by the start of 2022.

Funding constraints mean that the midlife update programme for the three MEKO 200 (PN) class frigates is likely to be less extensive. Whilst it seems that the precise extent of the modernisation has yet to be finalised, the upgrades are likely to focus more on addressing obsolescence in platform management systems than replacing existing weapons systems. The trade-off is that the modernised ships will not be as suitable for the most challenging scenarios as the revitalised 'M' class, being restricted to low- and medium-intensity deployments. However, it is intended to keep both classes in service until the mid-2030s.

In addition to the frigate mid-life updates, a separate modernisation programme is being carried out on the navy's five SUPER LYNXhelicopters to extend their lives in line with those planned for the frigates. An upgrade of the two TRIDENTE class submarines is also likely once the frigate projects are more advanced.

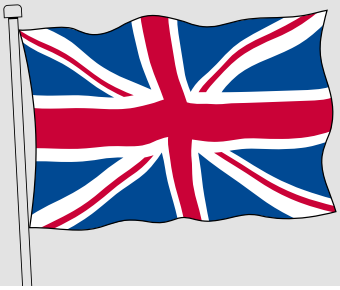
Conclusion

The Portuguese Navy has to fulfil considerable maritime responsibilities on a limited budget. The adoption of a two-tier structure has been a sensible approach to meeting this challenge. The navy's small force of high-end units has played an active and successful role meeting the country's collective security obligations to NATO and the European Union. Equally, its more numerous constabulary assets have ensured the ongoing security of Portugal's extensive EEZ. The fleet structure has also been sufficiently flexible to support broader international engagement, particularly to enhance the stability of African nations to its south. A recent, much heralded example, was the dispatch of ships to support the development of São Tomé and Príncipe Coast Guard in a year-long deployment.

The European financial crisis had a particularly severe impact on Portugal and the navy was not able to escape its effects. The suspension of the patrol vessel replacement programme hit the fleet badly. In particular, it resulted in continued reliance on legacy vessels that were expensive to operate and not ideally suited to the constabulary task. However, the fleet was able to maintain its overall size and structure during the years of austerity. With economic conditions now improved, much of the fleet recapitalisation programme is now back on track. The reconstitution of the former ENVC facility as the West Sea Viana Shipyard under seemingly more efficient management provides a firm basis for future new construction programmes.

Looking to the future, recent confirmation of the plans for more offshore patrol vessels and a new logistic support ship suggest the navy will retain a relatively prominent position in future Portuguese defence planning. There are some political concerns that the re-emergence of a potential Russian threat has shifted attention from NATO's southern flank, which is inevitably of more immediate relevance to Portugal's own security. Given this backdrop, Portugal will be reluctant to reduce its own maritime commitment to this area. Naval investment is also seen as having an important part to play in revitalising Portugal's industrial and technological base.

In conclusion, the Portuguese Navy has proved adept at weathering the storms of the last decade. Its most important modernisation plans are now well in hand, and it appears set to make further progress in the years ahead. ■



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Indonesia Faces Choices amongst Many

A Look at the Requirements of the Indonesian Land and Air Forces

Wendell Minnick

Indonesia's military budget consists of only 1.0% of the GDP, resulting in a purse of US$8.18Bn. To make matters worse, a witches' brew of international sanctions further confuse the situation.

The military has unresolved demands to replace its aging F-5E TIGER II fighter aircraft, but a Western replacement looks unlikely. Possible replacement aircraft include the Lockheed F-16V Block 72, GRIPEN C/D and the Russian Su-35.

A legacy of older sanctions on Indonesia from Europe and the US, now lifted, left many in Jakarta's defence circles embittered. More recent sanctions, in the form of penalties against Russian arms, have made things even more frustrating for Indonesia.

Photo: MoD Indonesia

Photo: PT Pindad

A KAPLAN medium tank prototype from FNSS during the 2017 Indonesian National Armed Forces anniversary parade.

Indonesia's military was forced to turn to Russia for arms after Jakarta was slammed by sanctions after the invasion of East Timor in 1999. Sanctions from the US (1999-2005) and European Union (1999-2000) forced Indonesia to procure Su-27 and Su-30MKK fighter aircraft to supplement its aging fighter fleet, which were further weakened by the lack of spare parts from the West.

Author

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Now, once again, new sanctions damage US efforts to sell arms to Indonesia due to a US Congressional Act placed on Russia and any country procuring Russian military equipment after Moscow's 2014 annexation of the Crimean Peninsula from the Ukraine.

Countering America's Adversaries Through Sanctions Act (CAATSA) was signed by US President Trump in August 2017. CAATSA can be waived for Indonesia if Jakarta has decreased reliance on Russia and/or procured additional US equipment, thus creating a loophole for the procurement of the F-16V Block 72 or GRIPEN C/D. The F-16V's maintenance costs are high in comparison with the twin-engine Su-35 and single-engine GRIPEN. The GRIPEN also has the option of carrying either US or European-made missiles. However, since the procurement of the Su-27 and Su-30, the fighters have proven themselves true work horses. Making the Su-35 an attractive option is the added advantage of reducing fear of future Western sanctions.

Though most analysts appear to favour the Su-35, it does face logistics problems. If the Su-35 deal goes forward, the deal will not include extra engines, which places Moscow in the 'parts and maintenance supply business', something the Russians are not famous for delivering in a timely manner.

Indonesia's defence industry will display their wares, alongside big international arms dealers, during a four-day event in November with their largest military exhibition and forum to date. Held at the Jakarta International Expo Kemayoran, 7-10 November, it will feature four concurrent shows held biennially: 8th INDO DEFENCE, 5th INDO MARINE, 6th INDO AEROSPACE and the 3rd INDO HELICOPTER.

Though these shows will attract an international collection of defence industry deal makers, it will be greatly overshadowed, unfortunately, by what is now the largest air show in Asia – China's Zhuhai Airshow, which is held concurrently with the Indonesian event. Zhuhai will attract heavy Russian arms industry participation, shifting attention away from poverty-stricken Jakarta to cash-in-hand Beijing.

Despite the shift in media attention to Zhuhai, Jakarta's tri-lateral defence show will still attract European and US defence industry interest. China is barred from buying US arms due to sanctions imposed on Beijing after the 1989 massacre.

Jakarta's fighter programme is not the only market for Indonesia's military. The army, navy and marines will be fighting for deals at this year's show and foreign defence manufacturers might see opportunities, though they will have to consider uncomfortable offset regulations that will require

foreign manufacturers to transfer highly-priced technology.

Indonesia's defence industry already produces land combat vehicles, medium-range fixed wing aircraft, and frigates in deals with Russian, Turkish and European suppliers.

In July of this year, the last batch of 155mm-armed M109A4 self-propelled howitzers (SPH) arrived in Jakarta from Belgium. Indonesia ordered 38 vehicles in August 2016 for the army. The second-hand vehicles included four artillery command post vehicles and an armoured recovery vehicle. The M109s are Indonesia's first SPH. The military already fields the South Korean KH-179 towed howitzer, French-made Nexter CAESAR truck-mounted howitzer and FH-2000 towed howitzers. Indonesia procured 36 CAESARs in 2012 and in February 2017 ordered 18 additional systems. The new CAESARs will be co-produced at PT Pindad.

Belgium and Indonesia also signed a deal for 150 M113A1 armoured personnel carriers (APC) in 2016, but only 50 have been delivered so far. Indonesia's military already has 155 M113 APCs in its inventory and it is not clear if it really needs an additional 100 vehicles.

Indonesia's PT Pindad and Turkey's FNSS are jointly developing the KAPLAN (BLACK TIGER) medium tank with production expected to commence in 2018 with 100 tanks, with the possibility of a total of 300 tanks, if the budget and possible overseas sales allow. The prototype is armed with a CMI COCKERILL 3105 105mm gun. Variants include a remote-controlled 20mm and 30mm cannon, and an amphibious variant armed with anti-tank missiles.

Photo: MoD Indonesia

In the presence of Indonesian Defence Minister Ryamizard Ryacudu, AH-64E APACHE attack helicopters were handed over to the Indonesian army at Semarang Air Base in December 2017.

Indonesia's Marine Corps took delivery of five Ukrainian-built BTR-4M 8x8 APCs in 2017 after a 2014 contract. The marines have a requirement for 50 amphibious vehicles, but budget and evaluation issues have troubled the programme, including unhappiness with the performance of the five delivered last year. The marines are rumoured to consider revising their original plan to procure more BTR-4M's and are looking at three possible contenders: Russian BTR-80, Turkey's ACV-19 and the South Korean K21.

For land-based air defence systems, Indonesia signed a deal with Kongsberg in October 2017 for the NASAMS-2 air defence system, armed with the Raytheon-built medium-range AIM-120 (AMRAAM) missiles. A present, Indonesia only has short-range Chinese-built QW-3 and the South Korean-built CHIRON for ground-based air defence needs.

Indonesia and Turkey are also jointly developing an unmanned combat aerial vehicle (UCAV) based on the ANKA. The medium-to-long endurance UCAV is under development by the Turkish Aerospace Industries (TAI) and Indonesia's PTDI. Plans are to have the manufacturing line producing the new UCAV by 2020. The air force requirement calls for 33 UCAV with a 5,000 km range.

In 2018, China's Jiangsu Digital Eagle Technology Development Company confirmed the sale of its YFT-CZ36 vertical take-off and landing fixed-wing surveillance UAV to Indonesia. Though the company did not identify the Indonesian government agency procuring the platform, it most likely will support law enforcement mission requirements along the border and coast. The four-rotor UAV has a range of only 4,000 m maximum altitude and a 3 kg maximum payload. ■

Mark your diary: Brussels, 29/30 January 2019
15th NATO Life Cycle Management Conference

MITTLER REPORT

From the Cradle to the Grave –
LCM as a Key Enabler for Capability Development

Chaired by: Thomas E. Pedersen and J. Bo Leimand (ret), Danish Defence Acquisition and Logistics Organisation (DALO)

The annual NATO LCM Conference will continue to consider the lessons learned and achievements made in areas such as Quality Assurance, Life Cycle Costing, Configuration Management, Acquisition Practices, Material Maintainability et al. as a basis for new and innovative, even disruptive approaches and perspectives which will be introduced in respective presentations. The event will again be organised in cooperation with the NATO Life Cycle Management Group (AC/327) and with the support of the NATO Industrial Advisory Group (NIAG) and the German CALS Forum. The conference will be combined with a small exhibition to showcase respective capabilities and will take place at the Parker Hotel Brussels Airport (formerly: Golden Tulip) on **29/30 January 2019.**

Contributing Organisations: Brazilian MoD, French MoD, UK MoD, NIAG, NSPA, SHAPE, NIIG, Eurostep, ILIAS Solutions, Nexter Systems, Qinetiq, SVGC, Systecon, TFD Europe, et.al.

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Advances in Air-Independent Propulsion for Submarines

Luca Peruzzi

The latest developments in Air-Independent Propulsion (AIP) technologies for submarines aim to extend their range while submerged and their duration of low-speed travel, while also maintaining a reduced acoustic and thermal footprint. As a result, the number of navies upgrading conventional underwater platforms with these systems is growing.

AIP systems are used for patrols at low speeds and for transport to and from the field, and batteries are the energy sources for high-speed cruises. Lithium-ion batteries for underwater applications have significant advantages over conventional underwater lead-acid batteries and contribute to the overall improvement of new and conventional platforms. While Stirling recirculation systems dominate the market, it is expected that fuel-cell-based AIP systems will change the market by introducing differently fuelled types that produce hydrogen instead of carrying it along; mixed with liquid oxygen, hydrogen is fed into the cell to generate electricity.

Photo: TKMS

The Type 212A class platforms (six in the German Navy and four in the Italian Navy) with Fuel Cell AIP are equipped with FCM 34 modules, which were developed from 1984 onwards for the German MoD.

Fuel Cells

As a leading manufacturer, thyssenkrupp Marine Systems (TKMS) has been developing fuel cells for submarines for 15 years (testing and development time not included). The TKMS AIP system is based on Siemens' solid ion-conducting polymeric membranes (polymer electrolyte membranes - PEM), which work by feeding industrial grade LOX and high purity hydrogen into the cell to generate electricity. This process does not require a generator; the fuel cell converts the chemicals directly into electricity in an electrochemical process – completely silently and at low temperature (80 °C). By using oxygen or hydrogen in liquid form stored on board and metal hydrides as reactants, the only product (aside from electricity, waste heat and a small amount of residual gases that enter the boat's atmosphere) is water, which can then be used for various purposes.

Both hydrogen and oxygen storage systems have proven to be very safe, as no accidents have ever occurred on German shipbuilding platforms. TKMS submarines are and will be equipped with two types of Siemens PEM fuel cell modules: the FCM 34 and the FCM 120, each with an output of 30–40 and 120 kW. The class 212A platforms (six in the German Navy and four in the Italian Navy) are equipped with FCM 34 modules, which were developed for the German MoD from 1984 onwards and were first launched at sea in 2002. The Type 212A platform broke a new record for

Photo: NATO

The Italian Navy developed plans for four additional Type 212A evolved boats with a domestic Fuel Cell AIP system combined with lithium-ion batteries.

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Photo: TKMS

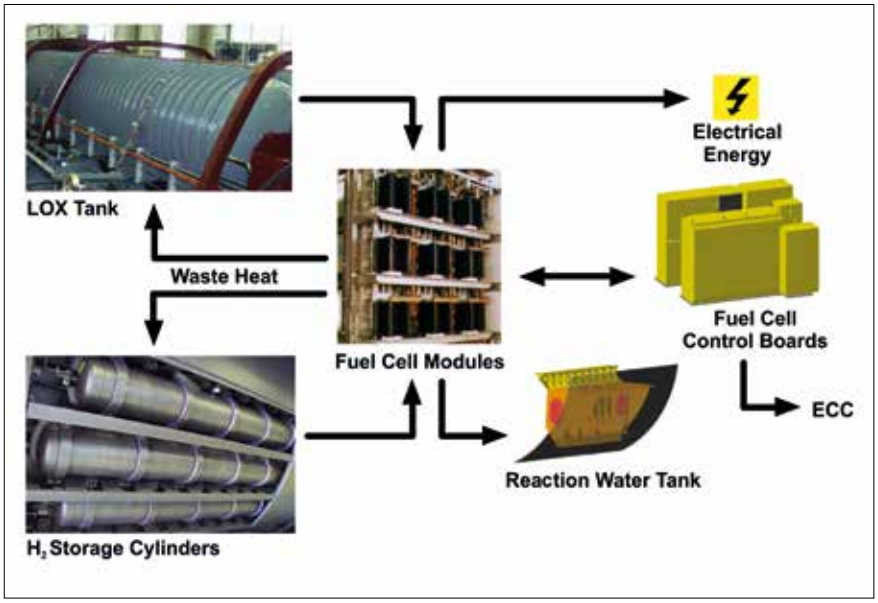


Diagram of the Type 212A Fuel Cell AIP system, showing the storage of reactants on the left and the production of energy and water on the right.

non-nuclear submarines in 2013, with 18 days of diving without snorkelling.

The Class 214 platforms operated by the Greek, the South Korean and the Portuguese Navy and soon the Turkish Navy are equipped with the more recent FCM 120 modules. The latest PEM fuel cell technologies have been used for the DOLPHIN II class TKMS boats built for the Israeli Navy. The Republic of Singapore has announced that TKMS boats of type 218SG equipped with a fuel cell AIP system are under construction for the city state. The so-called Type 212CD platforms being developed under the joint German-Norwegian programme will also be equipped with a fuel cell AIP system. Recent and future programmes could include the integration of recent AIP developments and the use of Li-ion batteries.

Methanol Reformers

Together with the Spanish company SENER, TKMS is developing a methanol reformer system for higher AIP requirements than the conventional metal hydride hydrogen storage system. The latter increases the weight and requires additional storage volume for higher AIP requirements and a displacement of more than 2,000 tonnes, making an alternative to hydrogen storage necessary. The methanol reformer for fuel cells can meet the durability requirements of larger submarines that spend more time underwater. The methanol solution chosen by TKMS extracts hydrogen from methanol and feeds it directly into the fuel cell. Methanol was selected for its worldwide availability, low reforming temperature (250 °C), simple reforming and high reforming efficiency (80 to 90%). The high hydrogen/carbon ratio in methanol reduces the consumption of liquid oxygen during production.

The waste generated by this process is pressurized CO2, which can be discharged into the sea at full depth. Each reformer can produce enough hydrogen to supply two full 120 kW cells, as proposed in a twin arrangement with four 120 kW FCs on board a customised Type 216 platform offered for the Australian MoD SEA 1000 programme. Under development since 1995, the reformed methanol system has received a Technology Readiness Level (TRL) of 5 to 6 during the UDT 2017.

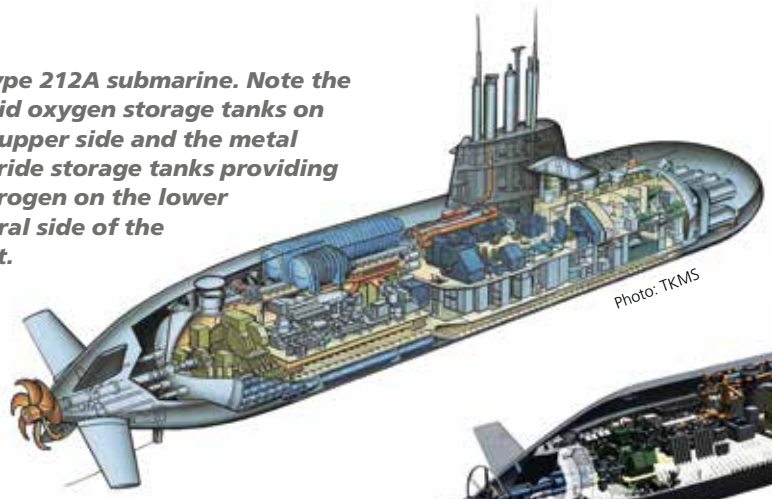
Based on the successful operational and industrial experience gained with the U-212A programme, and with the participation of national industry under the leadership of the Fincantieri Group, which has acted as prime contractor and submarine builder and integrator, the Italian MoD and Navy are developing plans for four additional boats, the first two of which are expected to be contracted by 2019 for deliveries from 2025 onwards. The new boats will be based on the U-212A submarine design, which features a higher national contribution in terms of technology, capabilities and equipment. The Italian MoD has invested heavily in the ambitious "Far Seas" military research and development programme, which aims to introduce new-generation lithium-iron phosphate batteries in addition to second-generation AIP fuel cells based on national technologies and industry developments. The first two boats of the Near Future Submarine (NFS) programme will contain the new batteries, while the second batch is expected to receive a second-generation AIP fuel cell, depending on the results of the R&D programme.

Based on joint research carried out by Fincantieri CETENA's Laboratory for the Development of Hydrogen Technology for Marine Applications and the University of Genoa in the field of surface ships, the Italian MoD's Naval Weapons Directorate is entrusting Fincantieri's industrial team with an R&D project aimed at developing and testing fuel cell modules of varying performance, derived from commercial technologies capable of working with synthetic air. The aim is to optimise the use of standard air/H2 stacks of pure oxygen with a cathode recirculation system that has already been tested in laboratories at TRL 4 and then integrated into the fuel cell rack with the required power.

The R&D project for a reduced-scale technology demonstrator also includes the development of a new metal hydride hydro-

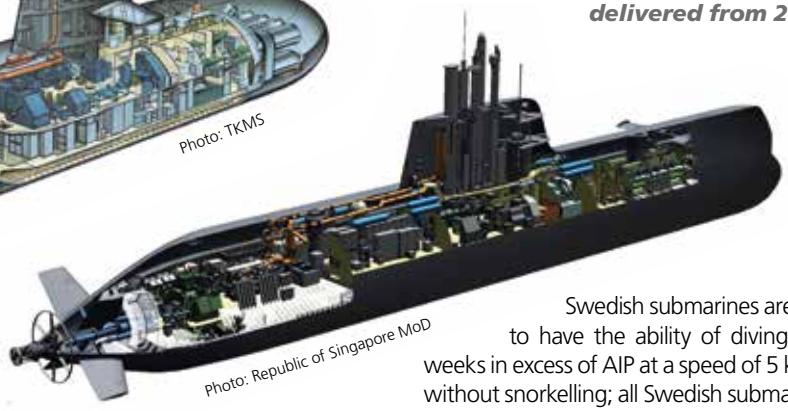
Photo: TKMS

The Type 214 submarines operated by Greece, Korea and soon Turkey are equipped with FCM 120 kW fuel cell modules.



A Type 212A submarine. Note the liquid oxygen storage tanks on the upper side and the metal hydride storage tanks providing hydrogen on the lower lateral side of the boat.

Photo: TKMS



Singapore has procured four tkms-built Type 218SG submarines equipped with Fuel Cell AIP to be delivered from 2021.

Photo: Republic of Singapore MoD

gen storage system and a new electrically powered mobile station for the production of hydrogen and oxygen by electrolysis with potential use of renewable energy sources. The aim of the programme, which is expected to last 29 months in three main phases, is to increase the performance of fuel cells and H2 storage as well as the reliability and lifetime of the systems and to reduce system costs. The second FC AIP will be combined with LPF batteries, an technology Italian MoD's naval armaments directorate started to investigate through a R&D programme that involves La Sapienza University in Rome, Fincantieri and the Italian Li-ion batteries firm FAAM.

This type of battery, controlled by an appropriate battery management system (BMS), has proven to be a suitable energy storage device for submarines, combining unprecedented performance with maximum safety. The R&D programme, which simulated single cell, module and string tests under laboratory conditions in the submarine cycle, has so far reached TRL 5, leading to an early engineering phase. The successful R&D results will allow the Italian MoD and Navy to incorporate the LPF batteries into the first two boats, which will improve platform capabilities of hybrid AIP submarines whose propulsion battery is the only energy source for maximum/emergency speed.

Stirling Engines

The Saab Kockums Stirling engine, developed and tested since the 1970s and used on submarines since 1990, is one of the most proven AIP systems. The Stirling is an external combustion engine that operates in a closed regenerative thermodynamic cycle. The system is also known as a hot air engine, because it is powered by the pressure difference in the working fluid at different temperatures. Low sulphur standard diesel fuel from on-board tanks and liquid oxygen, which is also stored in tanks, are mixed in a high-temperature burner at a temperature of 750° C, which serves as a heat source for a closed quantity of helium. The latter is driven by a repetitive sequence of thermodynamic changes.

By expanding the helium against a piston and then drawing it into a separate cooling chamber for subsequent compression, the heat from the external combustion of diesel and oxygen can be converted into electrical energy by a DC generator charging the battery. Since the pressure in the combustion engine is higher than at the maximum diving depth, the resulting water vapour and carbon dioxide can be dissolved in the seawater and extracted without compression, which is required deeper than 300 metres. Each Stirling engine can generate 75 kW of energy, with two or more engines installed on a submarine in soundproofed and rubber-suspended AIP modules, including the oxygen tank and auxiliary equipment.

Swedish submarines are said to have the ability of diving two weeks in excess of AIP at a speed of 5 knots without snorkelling; all Swedish submarines are equipped with AIP modules with Mk2 and Mk3 Stirling engines, which have also been retrofitted to older platforms. The fourth and latest generation of Saab's Stirling AIP module with a Mk3 engine, a GOTLAND Mid-Life Update (MLU) and A26 submarines equipment brings a number of improvements, such as the reduction in overall volume due to improved compression and higher operating efficiency, resulting in longer underwater life and other benefits that previous versions did not have, such as reusing waste heat for other underwater applications, which in turn reduces energy consumption. A Stirling AIP was also integrated into the two former VÄSTERGÖTLAND class submarines procured by the Republic of Singapore (now ARCHER class) and sold to the Japanese MoD. The latter is equipped with the Saab Kockums system licensed by Kawasaki Heavy Industries for the latest generation of the SŌRYŪ class in operation with the Japanese self-defence forces since 2009. The same technology

Photo: Saab Kockums

The future Swedish A26 submarines will be equipped with the latest-generation STIRLING AIP.

of the A26 platform family is requested by the Polish MoD for the forthcoming tender for three new submarines. Damen Group proposes a combination of Platform A26/ Stirling AIP for the upcoming acquisition programme to replace the WALRUS class boats in service.

The Spanish MoD and industry have developed an AIP system for the new generation of S80 submarines. Spain's procurement programme suffered from design and technical problems with both the platform and the propulsion system, postponing the delivery date and increasing programme costs. The propulsion system developed for the new-generation submarine fleet of the Spanish Navy was designed with a fuel cell AIP system based on reformed bioethanol and liquid oxygen. The original system suffered from development problems that led the Spanish MoD to assign the project to another Spanish company. In 2014, Técnicas Reunidas was awarded the contract to complete the development of the national AIP system, which recently reached an important milestone.

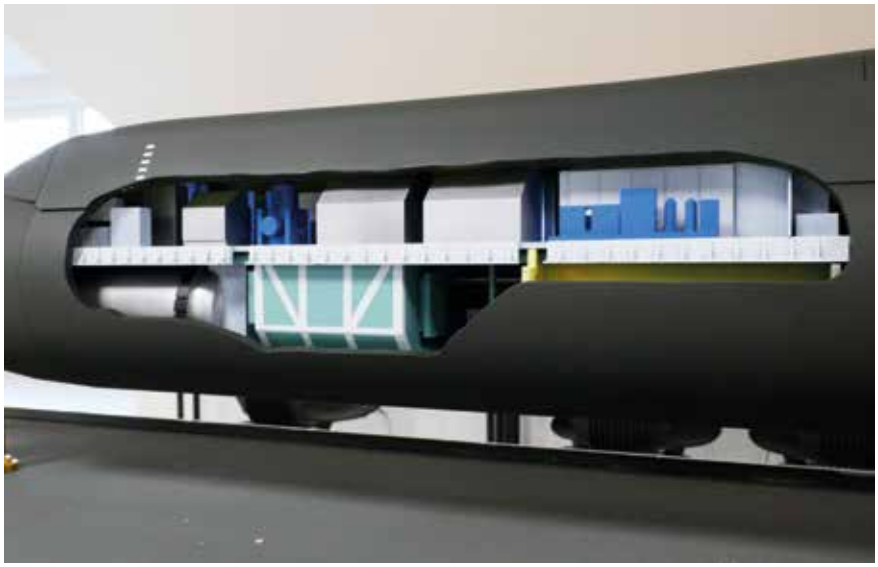


Photo: Saab Kockums

A close-up of the A26 propulsion section. The A26 submarine family can respond to different mission requirements with the addition of hull modules.

Photo: Saab Kockums

The first GOTLAND class submarine completed its mid-life update at Kockums shipyard facility last June.

Photo: South Korean MoD

Based on experience gained with the KSS-II/Type 214 depicted here, South Korea's DSME has recently launched a larger next-generation KSS-III boat equipped with an AIP system and domestically produced lithium-ion batteries.

The Spanish company has developed a miniaturised fuel cell AIP system that includes a bioethanol and liquid oxygen reformer for the production of hydrogen, which together with liquid oxygen supplies the fuel cell system. Its 300 kW power module is supplied by the US company UTC Aerospace. Bioethanol was chosen because of its higher purity when compared to ethanol and Spain's well-established production capacity. Allegedly, the miniaturised fuel cell AIP system has completed a 300-hour simulated mission equivalent to almost two weeks under AIP propulsion at low speed. The successful completion of this test enabled the Spanish Ministry of Defence to go ahead with the development of a full-scale system to equip the third boat, which is to be commissioned in 2024. The system will then also equip the fourth submarine, while the first two, which will not be equipped with the new fuel cell AIP system, will be retrofitted later. In the meantime, the two boats will be operated using the conventional diesel-electric system.

Following the sale of the Autonomous Submarine Energy Module (MESMA) system, which has been in operation since 2008 with the Pakistan Navy on board Naval Group's AGOSTA 90B submarine, the shipbuilder quietly developed a second-generation fuel cell AIP system (FC-2G) that is now ready for series production. The MESMA burns stored ethanol and oxygen in a combustion chamber to generate steam through a second cycle

(Rankine cycle loop) to drive a turbo generator that then charges the battery system. This system requires hydrogen and oxygen to be stored on board and is less efficient and has higher operating costs than the FC AIP.

Second-Generation Fuel Cells

To overcome these drawbacks, since 2012 Naval Group has been developing and testing a second-generation FC AIP that integrates the latest technology in diesel oil reforming to produce hydrogen from onboard fuel when needed. The use of a nitrogen cycle enables the use of air fuel cells, which reduces both oxygen consumption and operating costs. It also eliminates the need for long-term storage of hydrogen on board and the risks associated with other fuels such as ethanol. The modular FC-2G is supplied in a single large 10-metre hull section with a diameter of 6 metres (just like Naval Group's SCORPENE submarine), which includes all subsystems and is compatible with both conventional lead-acid and lithium-ion batteries of the latest generation. FC-2G AIP-equipped submarines like the SCORPENE can, as the Naval Group claims, dive at low speed for two to three weeks, depending on the mission. As an alternative, Naval Group also offers to add a new section with a large LIB module, so that SCORPENE submarines can only operate at low speed for seven days on LIBs and hold 12 knots for more than a day, which, according to the French shipbuilder, would open up new tactical possibilities.

In the rest of the world, countries such as Russia, India and China are seeking to introduce AIP systems on conventional submarines to meet both national and export requirements, while countries already using AIP systems want to continue developing the associated technologies. Based on operational experience with the KSS-II/Type 214 design, South Korean Daewoo Shipbuilding & Marine Engineering (DSME) last September launched the larger next-generation KSS-III first-of-class boat equipped with an AIP system and, according to unofficial sources, Hanwha lithium-ion batteries from local production. The Naval Metallurgical Research Laboratory (NMRL) of the Indian DRDO and Larsen and Toubro (L&T) are testing an AIP system based on a locally developed phosphoric acid fuel cell (PAFC) used on the new P75I programme boats. This follows the locally built KALWARI class boats, which are based on the SCORPENE design of Naval Group, in which a 10-metre-long extended section could accommodate the locally designed AIP. It is reported that China has developed a Stirling AIP system on board SONG/Type 39 and YUAN/Type 041 boats. The S-20 export platforms to be supplied to Pakistan by China Shipbuilding Industry Corporation will be equipped with AIP. The Russian design office Rubin proposes a version of the submarine Project 1650/AMUR (Project 677/LADA for the Navy of the Russian Federation) equipped with a fuel cell AIP that includes a standard diesel reformer for hydrogen production and fuel cells developed for the Russian space programmes that could be ready for both export and national applications in two years time, with the Russian Navy also being interested in the system.

The Japanese MoD and industry have been researching lithium-ion batteries for use on board submarines since the 1960s. Recently, the MoD announced that the two SŌRYŪ class submarines built by Mitsubishi Heavy Industries (MHI) and Kawasaki Heavy Industries and expected to enter service in 2020 and 2021, respectively, will be used as operational testbeds to evaluate the performance of lithium-ion battery technology to provide data for the service's next-generation submarine development programme. The Japanese GS Yuasa developer and battery system manufacturer will supply the lithium nickel cobalt aluminium oxide (NCA) batteries for the two boats under construction. According to the company's 2017 report, production started in April 2017 and deliveries are expected to start in August 2018. However, the Japanese MoD has not yet decided whether to equip the next-generation submarine with Li-ion batteries or an AIP system. These batteries are expected to provide similar performance to an AIP in combination with lead–acid counterparts at low speeds, while their benefits include longer life at higher speeds, such as in transit situations. ■

Photo: Naval Group

India's Naval Metallurgical Research Laboratory (NMRL) is testing an AIP system based on locally designed phosphoric acid fuel cells.

Photo: Naval Group

Naval Group has developed a second-generation Fuel Cell AIP (FC-2G) system.

Brothers in Arms

Guy Toremans

In the near future, the Belgian Naval Component and the Royal Netherlands Navy will receive new mine warfare capabilities.

As mine countermeasures (MCM) remain a key enabler for maritime forces, whether to maintain freedom of navigation for commercial shipping or 'punch a hole' for an amphibious assault, and with most of the European fleets' mine countermeasures vessels (MCMVs) approaching the end of their service life, navies have to recapitalise their MCM capabilities and reconsider the systems used. Today, there is broad consensus that unmanned and remotely controlled systems will constitute major game changers of naval minewarfare (NMW). Instead of using dedicated manned MCMVs to venture into the areas endangered by naval mines, future mine disposal concepts consider autonomous systems operating from less complex mother ships staying outside the mine warfare theatre in order to keep the sailors out of the minefields.

Photo: author

CROCUS, one of the Belgian Naval Component's six FLOWER Class minehunters, was launched on 3 September 1986. By the time of her replacement, she will have been in service for more than 35 years.

Author

Guy Toremans is a freelance naval journalist based in Belgium.

Congruent Concepts

Two of world's leading practitioners of naval minewarfare – the Belgian Naval Component and Royal Netherlands Navy – are pursuing a modular 'MCM toolbox' approach. Today, their mine countermeasures assets are underpinned by twelve 'platform-centric' TRIPARTITE class minehunters – each navy operating six units. The Belgian Naval Component's six FLOWER class minehunters, commissioned between 1985 and 1991, had become subject to a Capability Upkeep Programme (CUP-CMT) between 2005 and 2008, while the Royal Netherlands Navy's ALKMAAR class minehunters, commissioned between from 1983 through 1989, underwent their Project Adaptation Mine (PAM) programme upgrade between 2001 and 2007.

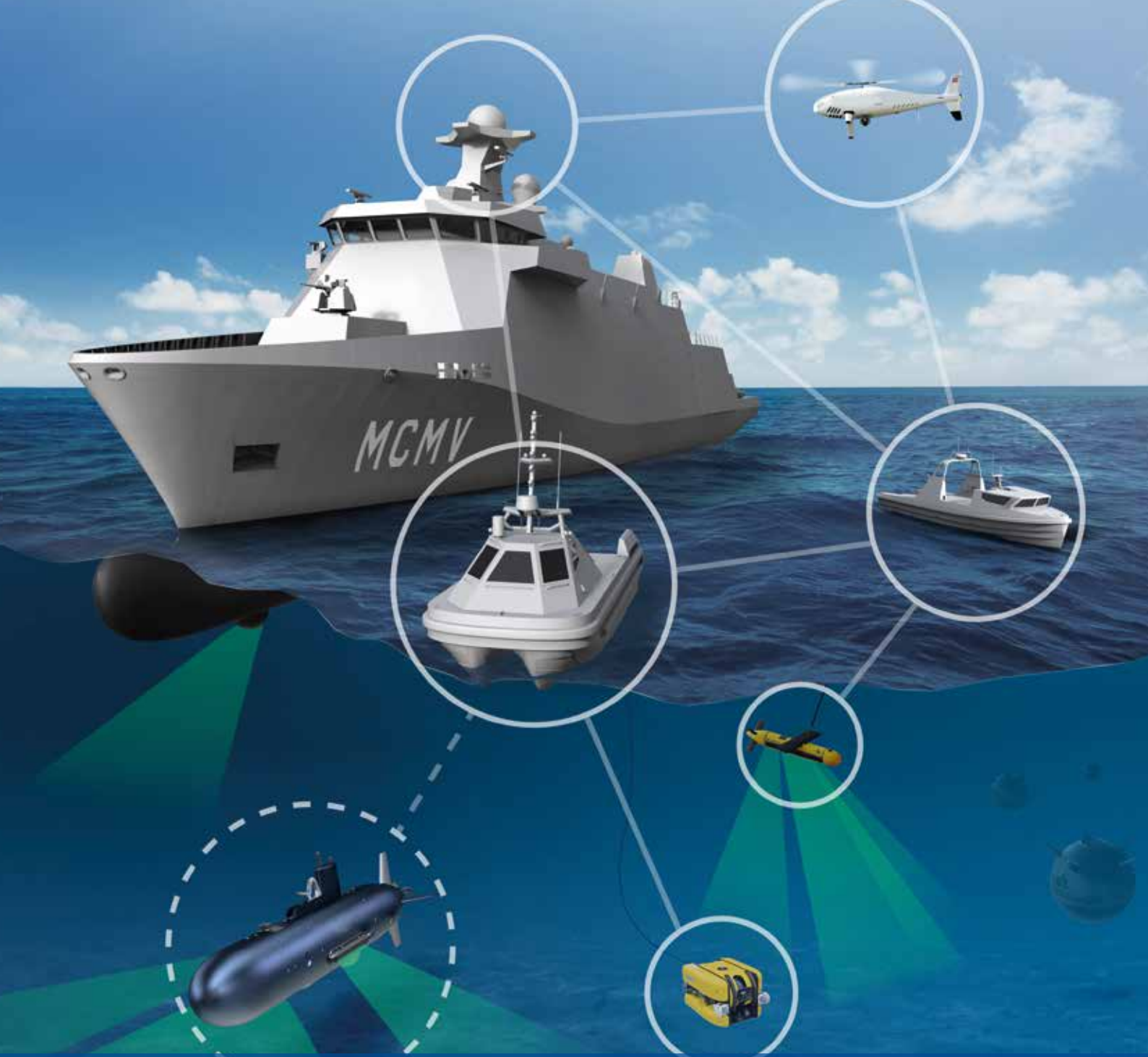
In 2012, the Belgian Naval Component and the Royal Netherlands Navy decided to align their future stand-off MCM programmes, and in 2015 the Belgian Defence White Paper headlined 'Strategic Defence Plan 2030 - The Strategic Vision for Defence' and the Netherlands Defence Whitepaper addressing 'Investing in People, Capabilities and Visibility' envisaged that their mine countermeasure vessels were to be replaced on a 'one-for-one' basis, with all mine countermeasures activities to be conducted by Unmanned Maritime Systems (UMS). In mid-2016 both navies announced the procurement of new MCM platforms, with each navy to receive six units. In November 2016, Belgium and the Netherlands signed a Letter of Intent (LOI) in which the two nations determined the replacement of their ageing TRIPARTITE Class MCMVs by the joint procurement of twelve new units. Hereupon the two navies commenced with defining their key platform and capability requirements.

Joint Procurement Effort

In January 2018, the New Generation Mine Countermeasure Vessel (NG MCMV) programme was formally launched with the Belgian Council of Ministers becoming the first to approve the acquisition of six NG MCMVs for €1.1Bn. On 8 June 2018, the Belgian Minister of Defence, Steven Vandeput, and his Dutch counterpart, Minister Ank Bijleveld, signed a Memorandum of Understanding (MoU) in Brussels which covered the common requirements for the NG MCMVs and determining Belgium to be in the lead for the procurement of the new MCMVs, while the Netherlands were to lead Future Frigate Programme for the joint acquisition of four surface combatants. The workshare reflects each country's particular area of naval expertise.

The Belgian and Dutch NG MCMVs will be quite innovative, featuring an MCM toolbox made up of systems capable of covering all types of MCM operations, including minehunting, minesweeping and explosive ordnance disposal (EOD) in order to counter mine threats in all potential scenarios, anywhere in the world.

It is yet to be determined whether the new vessels will be operated by joint Dutch–Belgian crews or, as another option, the new frigates will be operated by the Netherlands and the MCMVs by Belgium.



TAKING EUROPEAN COOPERATION TO THE NEXT LEVEL

WHEN BELGIUM AND THE NETHERLANDS JOIN FORCES IN REALISING THEIR NAVAL PROGRAMMES, IMTECH BELGIUM AND DAMEN ARE READY TO DELIVER THE FUTURE MINE COUNTER MEASURE VESSELS (MCMV). FITTED WITH A MODULAR TOOLBOX CONSISTING OF UNMANNED AERIAL, SURFACE AND UNDERWATER VEHICLES, THE MCMV WILL BE ABLE TO STAY OUT OF THE MINEFIELD.

ENABLED AND SUPPORTED BY BELGIAN AND DUTCH INDUSTRY PARTNERS, WE PROVIDE A FUTURE TO THE BENESAM SUCCESS STORY, WHILST CONTINUING TO SUPPORT SAFE PASSAGE IN OUR EU MARITIME DOMAIN.

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Photo: Thales

Thales' C-SWEEP ASV features a robust glass-reinforced plastic hull, twin diesel engines and is operated using the ASView Control System.

Capability Requirements

Both navies' prerequisites, jointly drawn up by the Belgian Directorate General Material Resources (DGMR) and the Netherlands Defence Materiel Organisation (DMO), were set up against a number of operational scenarios, such as access to sea ports; home and allied sea lines of communication and chokepoint protection; and expeditionary operations including amphibious operations. The top-line requirements called for platforms between 65 m and 85 m, a displacement in the 1,500–3,500 ton range, with signature/shock characteristics at least equivalent to a frigate, an Integrated Platform Management System (IPMS), an Integrated Bridge Management System (IBMS) and Integrated Battle Damage Control System (IBDCS), MCM systems capable of operating to a depth of 300 m, accommodation for EOD Diving, VSW MCM or special ops forces teams and an MCM staff, a diver decompression container, a crane capable of handling 20-foot TEU containers and a self-defence system against asymmetric air and surface threats, as well as adequate C4I facilities to ensure the full integration of the MCM systems into a Mission Management System (MMS). And with the Belgian Naval Component having decided not to replace its 52-year-old MCM command and support ship BNS GODETIA, each of the new MCMVs should also be capable of taking over the ship's tasks and feature sufficient space to accommodate an MCM staff.

To meet the outlined requirements for a credible global expeditionary capability, the platforms must be able to sail 3,500 nautical miles at a sustained speed of 15 knots and be capable to operate 'on station' for 30 days without interruption.

The MCMVs are to be equipped with a 'modular MCM toolbox' to provide an 'end-to-end' mine detection, identification, classification and neutralisation capability. This toolbox is to comprise a swarm of Unmanned Autonomous Vehicles (UAV), Unmanned Surface Vehicles (USV), a Mine Identification and Disposal System (MIDS) and an Influence Minesweeping System (IMSS). The new platforms must also provide growth potential for future new systems to be installed throughout their 30-year projected in-service life.

System Elements

Some of today's modular systems are Saab's AUV62-AT and DOUBLE EAGLE MkII, the FAST USV with both integrated and towed sweeps; Gaymarine's PLUTO GIGAS; Kongsberg's REMUS-100 (Mk 18 Mod.1 SWORDFISH) and REMUS 600 (Mk 18 Mod2 KINGFISH); ECA's SEASCAN Mk2, ALISTER 9A, ALISTER 18S and ALISTER 27M; THALES-ECA's ASEMAR; ATLAS Elektronik's SEA CAT, SEA OTTER Mk I and SEA OTTER Mk II; the Israeli ELBIT's SEAGULL and Textron Systems' CUSV.

Besides reducing risk to personnel, unmanned systems provide flexibility for the deployment of sensors and effectors into the areas of operation and allow easy transportation on land, in the air and at sea. This offers the possibility to extend the capabilities of surface combatants, amphibious vessels, commercial support vessels,craft-of-opportunity (COOP), offshore-based installations (oil-rigs) or shore-based facilities.

On 15 and 16 June 2017 the Belgian Directorate General of Material Resources (DGMR) organised the "Technology & Industry Days" during which several industries showcased different types of unmanned underwater and autonomous surface vehicles in a 2 NM x 2 NM exercise minefield laid off the naval base of Zeebrugge. Among others, these included:

- The French ECA Group demonstrating its A9-M, the A27-M AUV equipped with a Thales SAMDIS synthetic aperture sonar, and an INSPECTOR USV, the latter deploying two SEASCAN Mk2 ROVs.
- Israel's Elbit Systems showcasing its SEAGULL 12 m USV, configured with an R2Sonic forward-looking sonar and a Klein K5900 side-scan sonar. Subsequently, the same SEAGULL platform operated a VideoRay remotely operated vehicle. During the demonstration, SEAGULL scanned areas at a cruise speed of 10 kn and in sea state 5–6 conditions.
- ATLAS Elektronik UK demonstrating its ARCIMS USV, configured with a Northrop Grumman AN/AQS-24B towed synthetic aperture sonar and laser linescan sensor, plus two canistered SEA FOX C rounds. Following an unsupported 36 km transit to the exercise area off Zeebrugge, the USV executed a six-hour mission using both remote control and autonomous modes of operation.
- THALES showcased its 10.8 m rugged high-performance C-SWEEP multirole Autonomous Surface Vehicle (ASV).

Picture: STX France

The STX DeviceSeas has been designed as a multipurpose mother ship with hydrographic and mine warfare capabilities.

International Competition

Upon completion of the technical specifications, a Request for Proposals (RfP) was sent to the European Union in April 2018. It is noteworthy that this is the first time in Dutch history that a procurement programme for naval vessels is made subject to international tenders, although the shipbuilding capacity to construct these new MCMVs is available

in-country. Initially, five companies submitted bids, namely the British BMT Group, a consortium of DAMEN Schelde Naval Shipbuilding and IMTECH Belgium NV), the French NAVAL GROUP, the Swedish Saab Kockums, and the SEA NAVAL SOLUTIONS, a consortium of the Belgian Engine Deck Repair NV, STX France, SOCARENAM and THALES Belgium. Following a series of value management dialogues, the NG MCMV project team downselected the possible candidates to four.

The shortlist comprises:

- Saab Kockums AB proposing its "Mine Counter Measures Vessel 80". At 80 m and displacing some 1,250 tons, this design features an integrated command centre (ICC) e.g. co-locating the ship's bridge, combat information centre, and machinery control spaces, deck space for containerised mission modules, and two stern ramps and a crane to allow the launch of USVs, AUVs, ROVs, RHIB's or interceptors. A helicopter flight deck and UAV hangar can be added.
- Details of the French NAVAL GROUP's MCMV bid have not been disclosed but is believed to be of a Bâtiment Anti-Mines Océanique (BAMO) type design.
- DAMEN Schelde/Imtech are probably offering one of their Multi Role Auxiliary Vessel (MRAV) designs, such as the MRAV 1600 and MRAV 3600 variants. With a length of 61.5 m and a displacement of some 1600 tons the MRAV 1600 version provides accommodation for up to 43 and can carry six 20-foot containers. The MRAV 3600 variant is 84.5 m long, displaces some 3,600 tons and can take a crew of up to 59 and accommodate up to twelve 20-foot containers.
- SEA NAVAL SOLUTIONS proposes its DeviceSeas concept, unveiled by STX France at Euronaval 2016. At 80 m and displacing some 3,700 tons, the vessel can embark two USVs and up to eight AUVs and ROVs, housed in a dedicated hangar, and sufficient deck space for accommodation of two 20-foot containers. The DeviceSeas also features a launch and recovery system, developed jointly by STX and the offshore industry specialist NOV BLM (National Oilwell Varco/Bloomberg), allowing the deployment of drones measuring up to 12 metres and ranging from 80 kg to 19 tons.

Picture: Saab

Saab Kockums' MCMV 80 design was first publicly presented at UDT 2017 in Bremen, Germany.

Programme Milestones

The proposals from the four shortlisted contenders have to be submitted by 2 Ocober 2018, following which the Belgian Directorate General Material Resources (DG MR) and the Netherlands Defence Materiel Organisation (DMO) evaluation teams will analyse the cost/benefit ratio of the proposed designs against the capability requirements and how the functional requirements can be met in terms of delivering operationally durable and financially sustainable MCMVs. This analysis is anticipated to be concluded by late 2018. The results will be presented to the ministries of defence, with parliamentary approval expected before the end of the year. This timeline would allow the signing of a construction contract by 2020 and the building kick-off by 2021. The Belgian Naval Component could receive its first NG MCMV in 2023 while the first ship flying the Dutch flag could follow in 2025. The last platform is scheduled for delivery in 2029.

More International Cooperation?

Belgium and the Netherlands also remain open for cooperation with additional international partners.

With France to replace its eleven ERIDAN Class (TRIPARTITE type) minehunters, the Royal Navy looking at the replacement of its eight HUNT and seven SANDOWN class minehunters, and the German Navy planning to renew its entire MCM fleet the joint procurement of MCM systems could be a possibility.

However, France and the UK have different national drivers with regard to mission requirements, for example, their emphasis is more on en-route survey operations in order to keep the approaches to their nuclear submarine bases open. Both these navies also want to perform 'up threat' expeditionary MCM operations at extended reach. Hence the French/UK Maritime Mine Countermeasures demonstrator system programme is focusing on an an 'end-to-end' capability based exclusively on offboard vehicles, sensors and effectors, while the German Navy's new MCM inventory should be made up by both dedicated platforms and organic MCM modules to be accommodated on board larger warships. Dialogues are ongoing with these navies although this is not necessarily the course that the BE/NL programme will follow. ■

Picture: Damen Schelde

Artist impression of Damen Shipyard's 62 m MRAV 1600 design, which is part of a family of multi-role auxiliary vessel platforms that can be equipped with dedicated mission modules.

Train Hard in Practice and Bleed Less in War

Force Multiplication through Training for Today's Flashpoints

John Antal

Training is everything. Training for the right war, with the correct intensity and frequency prior to battle, is priceless. Imagine a worst-case scenario: In the near future, well-trained combined arms formations, with experience in multi-divisional operations from recent large-scale military exercises, and armed with the latest combat technology, attack across the narrow 65-kilometre-long corridor on the borders of Belorussia, Lithuania, Poland, and the Russian fortified enclave at Kaliningrad. This area is called the Suwalki Gap and it is one of NATO's weakest points against a growing threat. A July 2018 study by the Centre for European Policy Analysis stated: "The Suwalki Gap is where the many weaknesses in NATO's strategy and force posture converge." The gap contains one railway line and several narrow highways that separate European NATO from the Baltic NATO states of Lithuania, Latvia, and Estonia. The attacking forces use large-scale manoeuvre exercises in Belarus to cover the build-up of their forces. The attack is a surprise. The attackers disable space-based satellites and GPS signals while simultaneously blanketing the strike zone with electronic jamming and spoofing. At the same time, worldwide cyber-attacks create confusion across the cities in Europe and the US. Neutralised by electronic jamming and the loss of satellite feeds, spoofed with false data, and denied the brilliance of their technology, NATO forces are knocked off balance. The attacking combined armed forces, supported by a full spectrum of air and naval units in the Baltic Sea, cut through the NATO defenders. The defenders fight bravely in the confusion and fog of degraded operations. In 96 hours, the attackers control the Suwalki Gap. The attackers then go to ground to defend against an expected NATO counterattack. NATO counteractions, however, are problematic. Enemy Anti Access/Area Denial (A2/AD) systems make an amphibious operation a costly prospect and an airborne operation futile. Much like the German blitzkrieg in France in 1940, the Allies are stunned and knocked off balance. NATO is committed to defend its members, but nuclear tensions are rising. The attackers have ISKANDER nuclear missile launchers in Kaliningrad. No one wants a nuclear war. China makes a well-prepared offer to broker negotiations and, in the end, the attackers remain in control of the corridor of land to Kaliningrad. NATO is split and impotent. The familiar "stab, grab, and hold" tactic has worked again, just as it did in Crimea and Georgia. "In one fell swoop you have sort of proven that NATO does not work," Magnus Nordenman, director of the Transatlantic Security Initiative, told the Marine Corps Times on June 11, 2018. "American defence guarantees are not worth the paper that they are written on." Lithuania, Latvia, Estonia, and Ukraine could be next.

How do military units win in situations where they are surprised and outnumbered? Historically, training and leadership are the major factors that multiply the combat effectiveness of an army. In the Suwalki Gap scenario, NATO forces were surprised, outmatched, outfought, and could not employ their systems as they had trained. The NATO forces had not exercised at the intensity or fidelity required to provide a battle-winning advantage. The opponent, on the other hand, had studied the systems, methods and tactics of their NATO adversaries and devised a holistic counter-pattern that included cutting-edge equipment, intense training, and surprise. In this scenario, NATO leaders realised too late that they had trained for the last war, not the current fight. Fighting outnumbered and possibly outmatched is the reality that NATO faces in several flashpoints, particularly in the Suwalki Gap. The US, the cornerstone of the NATO alliance, has only nine Armoured Brigade Combat Teams (ABCTs) in the entire US Army, and only one or two of these are deployed to Europe at any given time.

Photo: US Naval Institute

For the first time a NATO exercise in 2017 focussed on defence of the Suwalki gap against a Russian attack.

Author

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European NATO members are stepping up by increasing funding, modernising their forces, and participating in exercises, but an emphasis on training for high-intensity combat is needed. After 17 years of fighting in counterinsurgency operations, the US military and NATO partners must retool and retrain for high-intensity combat. The most important question is whether NATO can train enough units in time to provide a convincing deterrent for situations like the Suwalki scenario?

Photo: Pvt. Randy Wren / US Army

Soldiers attack simulated enemy combatants during exercise ALLIED SPIRIT IV at the Joint Multinational Readiness Centre at Hohenfels Training Area. The Germany-based CTC has a worldwide mobile training capability and can train leaders, staffs, and units up to brigade combat teams (+) and multinational partners.

Training for High-Intensity Combat

To prevent a war from occurring, NATO units must be trained for high-intensity combat operations against the most likely peer-adversary. Emphasis must be placed on multinational interoperability gained through combined training exercises. Winning across all operational domains – air, land, sea, space and cyberspace – is the goal of this training. Degraded-mode operations, when electrical systems are jammed or spoofed, should be a major part of the exercise strategy. To achieve this goal, NATO needs to enhance its training efforts. All modern military forces train in Live, Virtual, and Constructive (LVC) training environments to create maximum return on training resources. Live training involves people operating real systems on real terrain. Virtual training involves people operating synthetic systems over digitised terrain. Constructive training has synthetic forces operating synthetic systems. This blend of LVC was first done effectively back in the 1980s during what the US Army calls the "first revolution in training" with the creation of the Combat Training Centres (CTCs) such as the National Training Centre at Fort Irwin, California. CTCs, like the Joint Multinational Readiness Centre, the Germany-based CTC, have a worldwide mobile training capability, and can train leaders, staffs, and units up to Brigade Combat Teams (+) and multinational partners. This effort changed how US and NATO forces trained for war, bringing a rigour and intellectual focus that generated training overmatch that was proven in battle from the 1990s until today.

Live training at the CTCs is still the most effective training for military units, but it is also the costliest in terms of resources. Most units will only experience one CTC rotation. Repetitive, larger-scale manoeuvres are unlikely due to costs and resource constraints. As warfare has changed and become more complex with increasingly sophisticated technology, more training iterations are required to achieve the level of training demanded for high-intensity combat operations. Linking LVC simulations together into an integrated synthetic training environment has been an unachievable goal until now. The answer to this challenge is to mesh LVC into a single software solution called the Synthetic Training Environment (STE). The STE is considered the 2nd revolution in training and will fundamentally change the way military units prepare for war by enhancing realistic training in all combat domains. The STE is the convergence of the LVC environments that will augment live training, link existing training sites, and provide training services to ground, dismounted and aerial platforms and command post (CP) points of need (PoN) all in one simulated battlespace. It will provide multi-echelon teams the ability to train in immersive, interactive, and memorable training in the same battlespace even when thousands of miles apart.

Merging LVC simulations into one accessible training environment will narrow the difference between training and combat. The STE will allow soldiers and units to train, plan, and rehearse like never before. Units and staffs will experience the characteristics of the actual battlespace they will fight in through precisely rendered digital terrain. The STE will incorporate a One World Terrain (OWT) map capability that will deliver any terrain in the world, with a game operating system that will enable the rapid development of any scenario and include a sophisticated AI that can operate as the enemy. The STE will "provide a cognitive, collective, multi-echelon training and mission rehearsal capability for the operational, institutional and self-development train-

Photo: NordNordWest

To the military planners of NATO, the Suwalki gap (named after the nearby town of Suwalki) is a tough-to-defend flat narrow piece of land, a gap, that is between Belarus and Russia's Kaliningrad enclave and that connects the NATO-member Baltic States to Poland and the rest of NATO.

ing domains," the US Army Acquisition Support Centre stated in a 2017 report. "It brings together the virtual, constructive and gaming training environments into a single STE for Army Active and Reserve Components as well as civilians." STE can represent an unlimited number and type of threats and environments and can be used to develop better tactics, techniques and procedures (TTP) in rapid time and at no cost in blood. "From wherever they may be located, home station, armouries, institutions, or deployed locations, we want our soldiers to enter into a synthetic training environment that immerses them in diverse complex operational environments that replicate where they will fight; with who they will fight with; on the terrain they will fight on!" Maj.Gen. Maria Gervais, Deputy Commanding General, Combined Arms Center - Training (CAC-T) declared in October 2017. Maj.Gen. Gervais also serves as the Cross Functional Team (CFT) Lead for the STE under the auspices of the recently activated Army Futures Command.

Photo: CEPA

A 2018 CEPA study highlighted the risks of the Suwalki Gap.

The STE will interact with and augment live training, which is the pinnacle of all military training. With the STE, units across NATO could practice the Suwalki Gap mission from distributed sites, in their home countries, with existing augmented reality (AR) and virtual reality (VR) training systems. This can increase the number of training iterations that units, staffs, and multinational headquarters can experience together. In addition, the STE's open-architecture software promises to allow the training unit to operate under multiple battle environments, including mega-cities, cyber-attacks, electronic warfare, and space operations – all of which are difficult or impossible to simulate with current training systems. AR systems will allow participants to have real-time interactions with avatars representing key participants who may be miles away. "The STE will provide the warfighter with the repetitions necessary to rapidly acquire and master the individual through BCT collective skills necessary to train to win in Multi-Domain Operations." Importantly, the STE is a software solution and will not require proprietary hardware and can leverage commercial-off-the-shelf computers, augmented reality systems, and virtual reality systems. The US Army is working hard to create an STE where LVC will also link live platforms to manned simulators and constructive forces. The STE will be accessed throughout the US Army via the Department of Defence Information Network and is expected to be ready by 2020 or 2021, but this needs to be accelerated and then shared with NATO as soon as possible.

To the casual observer, the Suwalki Gap may not seem worth going to war over, until you understand its significance to NATO. During the Cold War, the US and NATO swore to defend their portion of the City of Berlin, even though it was surrounded and totally outmatched by Russian and Warsaw Pact Forces. NATO's willingness to stand united to defend Berlin, in spite of the impossible tactical situation, became a factor in the inevitable defeat of the Soviet Union. It is significant that the Cold War ended with the fall of the Berlin Wall. Today, the Suwalki Gap is a potential flashpoint and a wake-up call for NATO. In this scenario and others, NATO forces will be contested in all domains of war by an adversary with matching or overmatching technologies and by greater numbers. The US Army understands the urgent need to prepare for high-intensity operations and Gen. Mark Milley, the Chief of Staff of the Army, and the Honorable Mark Esper, Secretary of the Army, have articulated this in the army vision: "Focus training on high-intensity conflict, with emphasis on operations in dense urban terrain, electronically degraded environments, and under constant surveillance. Training must be tough, realistic, iterative, and dynamic. Continuous movement, battlefield innovation, and leverage of combined arms manoeuvre with the Joint Force, allies, and partners must be its hallmarks. This training will require rapid expansion of our synthetic training environments and deeper distribution of simulations capabilities down to the company level to significantly enhance soldier and team lethality."

In preparation to meet the threat, NATO has executed a series of multinational exercises, such as the Saber Strike and Operation Atlantic Resolve exercises, across the Baltics and Poland, to demonstrate the commitment and solidarity of the alliance. At the same time, the US and NATO recognise the need to train for high-intensity combat and to emphasise training under degraded conditions. Simultaneously training in multiple domains to develop individuals, units, and staffs in training exercises that are immersed in ambiguity, degraded operations, and chaos will be the future of effective military training. Acceleration of the development and deployment of the STE, and the early adoption of the STE by NATO, will be a significant investment in deterrence. The STE will become a vital enabler of high-fidelity, multi-echelon and multinational training and promises to allow NATO partners to intelligently and seamlessly train at many locations across a meshed LVC network with multinational partners. Every advantage in war is fleeting, so NATO is in a race against time. There is no one single solution to gain victory. Historically, the better trained army, not the best equipped, usually wins the day. Enhanced training is one of the best ways to improve the effectiveness of deployed forces. Train hard and bleed less. ■

Weapon Ranges: In the Field, Indoors and Virtual

William Carter

Weapon ranges come in all shapes and sizes, from small indoor systems where weapons are fired over distances as little as 50 feet, to aircraft ranges that use GPS tracking and can be hundreds, even thousands of kilometres in extent.

Sometimes bullets, shells and missiles are fired, sometimes lasers replace bullets, and sometimes nothing is fired at all, because weapon effects are simulated using computer programmes. Then there are complete simulations where no actual range space is used because the whole exercise uses simulation training technology, the so-called Virtual world.

Graphics: via author

Weapon range missile firing - real and simulated

Indoor Live-Fire Ranges

Much indoor shooting training is on ranges with 50 or 75 feet between firing points and the targets. Some small shooting ranges can be trailer-mounted rather than inside buildings in a training complex, so that the trailer can be driven to the unit to be trained. In some designs, two trailers can be placed end-to-end to double the distance of fire. Shooting ranges in indoor training complexes can extend up to 150 feet, and are often divided into bays, particularly if there are many firing points. For instance, a range with ten firing points can be divided into two bays of five firing points; a twelve-point range into two bays of six, and so forth. Training can then take place in one bay without unwanted interaction with other bays; shooters can be separated by type of firearms or skill level, and bays not in use can be serviced while shooting goes on elsewhere and there is no need for ventilation to remove gases and traces of lead.

In small live-fire ranges, a "bullet trap" system is used so that spent bullets do not ricochet around the training area. However, if there is an irregularity in either the bullet or the trap surface, or the bullet strikes a hard surface at 90 degrees rather than at an angle, it can break up into what is known in the trade as "backsplatter" of small particles, which are more difficult to trap than complete spent bullets. It follows that it should not be assumed that any bullet trap is completely effective, and eye protection should be used on small live-fire ranges. Many small rounds are "jacketed", where a soft lead core is surrounded by a case of harder metal. Where low velocity jacketed ammunition such as the .45 inch ACP (Automatic Colt Pistol) round is used, the jackets can remain intact after impact, and occasionally can bounce out of even the best bullet traps. With higher velocity bullets such as 9mm and semi-automatic cartridges, the jackets usually fragment on impact and the sharp edges of these particles make them particularly dangerous, showing why live shooting on small ranges should take place as far away as possible from the face of a bullet trap.

Target retrieval systems can be used so that results can be analysed without shooters needing to leave their firing positions. Targets can be simple "bulls-eyes" or more complex target models including those that have pictures and can turn or drop, to train the shooter in quick reaction skills. Targets can give shoot/no shoot training, for instance where the target picture is of a young woman who is carrying or aiming a pistol, or a picture of a man carrying a parcel rather than a gun.

Outdoor Firing Ranges

These can be much larger, and targets can be based on boards on which are real-size pictures of potential targets, which can be soldiers, civilians or vehicles including tanks. The boards can be mounted on powered target-lifters under Exercise Control (ExCon) which can be made to pop-up or turn at appropriate moments in an exercise. Vehicle targets can be mounted on motorised wheels or on small rail systems that are invisible to the people being trained and allow the target to transit realistically across the range area. Outdoor firing ranges need safety systems to minimise the risk of injury, both to

the firers and the local population. For example, India is building 17 new so-called "baffle" firing ranges at a cost just over US$2M per range, each of which will be between 15 and 20 acres in area. The new ranges are for live fire over distances between 300 and 500 metres, and are in addition to 60 other firing ranges in India. The design is such that misdirected bullets, ricochets and backsplatter are blocked by a system of baffles that consist of ground barriers, side walls, and stop butts, and the system is said to be safe up to a 14 degree divergence from the intended line of fire. The object is not only to reduce the risks on-range but also to prevent bullets and fragments going off-range, particularly where there has been growth of civil population close to Indian army training areas.

Large Military Range Areas

These are suitable for military exercises using tanks, guns, infantry, helicopters and fixed-wing aircraft. Such exercises take a long time to plan and in many cases lasers are fired rather than bullets. The lasers are coded and when combined with GPS tracking of all exercise entities, provide a detailed database for After Action Review (AAR). In Germany, the largest is the Bergen-Hohne Training Area (Schießplatz Bergen-Hohne) in the southern part of Lüneburg Heath, south of Hamburg, with an area of 284 square kilometres (just over 70,000 acres). In southern Germany the US Army Hohenfels training area north of Munich is the largest in US Army Europe (USAREUR) and is part of the Grafenwoehr Joint Multinational Training Center. There is also the German Army's 15 x 30 km Altmark training area north of Magdeburg, within which is a training facility called GefechtsÜbungsZentrum Heer (GÜZ), a literal translation being the Battle Exercise Centre of the Army.

Urban Training

Part of the GÜZ complex mentioned above includes the so-called "Schnöggersburg" training town. This has some 16 km of roads from trackways to a four-lane highway, and some 200 tall buildings with open squares of various sizes in which demonstrations including riots and other public disorder can be arranged for training purposes. There is a 22-metre-wide river with five bridges, including a removable mid-section to demonstrate demolition. Underground tunnels connect three metro stations, and there is a 650-metre-long sewer system through which specialist squads can be inserted into buildings or into roads through manholes. Above-ground facilities include a railway station with 1,500 metre of track, a waterworks, power station, church, mosque, and synagogue. About twenty buildings are reinforced to allow helicopter landings. An "industrial district" has larger buildings, and a dummy chemical factory can be used for chemical leak training. The next phase of development is scheduled to be finished in 2020 and is to model the outskirts of the town, in which 108 buildings will form a residential area and barracks. An area with destroyed infrastructure with 250 smaller buildings will allow troops to prepare for special threats. Such military training towns are for Military Operations in Urban Terrain (MOUT), originally a US Army term but universally understood and often used by other nations in preference to other terms such as Fighting In Built-Up Areas (FIBUA). The initials "UO" are also used, standing for Urban Operations. Although Schnöggersburg is probably the largest MOUT training complex in Europe, there are many others, some of which are described below.

Other Urban Training Systems

In France there is the Jeoffrécourt training village at Sissonne, north of Rheims; in the Netherlands there are the Marnehuizen and Oostdorp training villages in the Marnewaard military training area in the north of the country; and in Italy there is the Dandolo MOUT training facility North of Venice. In Belgium, MOUT training has taken place at Camp Roi Albert, South of Liege; in Poland at Wedrzyn, west of Poznań near the border with Germany; and in Spain, at Naval Station Rota, north of Cadiz. In the UK, MOUT training sites include Copehill Down on Salisbury Plain and "Ishmara Village" in East Anglia, the latter being modelled on a village in Afghanistan. In Israel there is a 20 sq km training city at the Tze'elim Army Base in the Negev Desert, just east of the Gaza Strip. In the USA there are many MOUT training complexes, not only in the US Army, but also in the Marine Corps, even the US Navy, the latter for training its Sea, Air, and Land teams (SEALs) at San Clemente island, in the Pacific south of Los Angeles. An example of US Army MOUT facilities is Fort Irwin in the Mojave Desert, California, which has a training site with over 100 buildings, mainly modelled on a Middle Eastern city. The US Marine Corps has a 274-acre MOUT facility at its Twentynine Palms base, northeast of San Diego, California, on the coast near the Mexican border. This has over 1,500 buildings, including seven different types of urban areas. Also in the USA, papers have been published suggesting the creation of a centralised Urban Warfare School to co-ordinate all DoD MOUT/UO training and centralise the learning from exercises in all US services and from real UO battles such as in Baghdad, Fallujah, Mosul and Ramadi, but so far without such a plan being agreed by Pentagon authorities.

Sea and Air Ranges

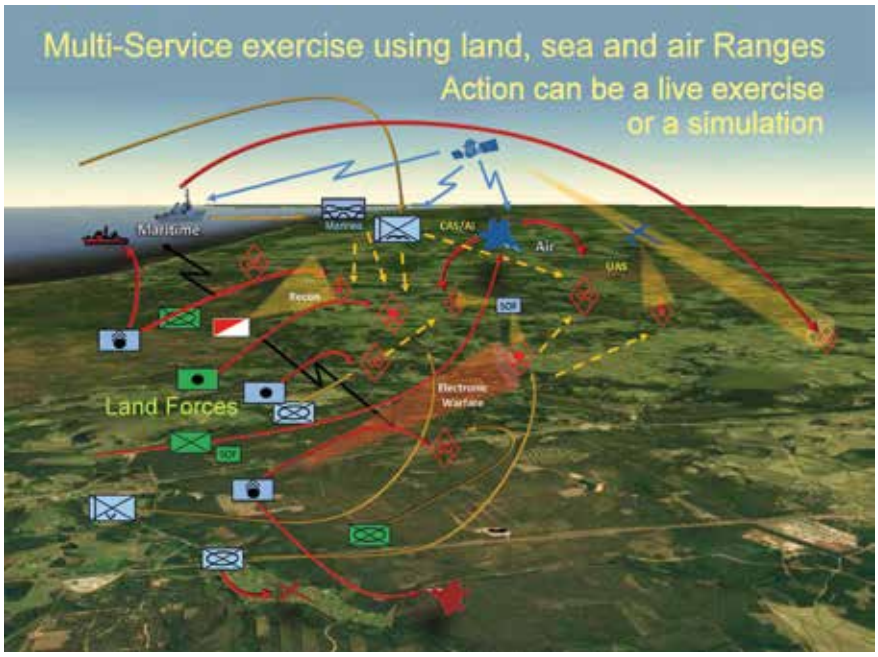
Military Air ranges and Navy Sea/Air exercise areas can be of almost unlimited horizontal and vertical extent because they are not limited by the constraints of

land-based ranges such as nearby areas of housing, industry, roads, railways, or other civil infrastructure. However, sea ranges are constrained by commercial ship lanes and fishing areas, and air ranges by commercial airways and control zones. If live weapons are to be fired, there are the usual safety constraints, particularly if the range volume is over land. Normally, weapons fired on such exercises will be training rounds without full explosive warheads, and, in the case of guided missiles, will often have special instrumentation to provide data for After Action Review (AAR). In these air, sea and land exercises, data from instrumentation in aircraft, ships, military vehicles, weapons and soldiers, combined with GPS tracking, allows more comprehensive After Action Review than ever before. In complex exercises such as this, the Review stage should take longer than the exercise itself so that full benefit can be extracted for the future, and to allow subsequent exercises to show improvements.

Simulation for Versatile Military Training

Exploiting the virtual world with its use of modern simulation technology opens up many possibilities. For infantry training, projectors and screens can be used to show a variety of images to soldiers who can use replica guns that "fire" lasers rather than bullets. Sometimes the gun fires nothing at all but its aim, position, and trigger-pull are recorded and the effect is calculated by the simulator's computer. In most infantry systems, large screens are placed in front of a replica platoon firing position, and in larger systems several "wrap-around" screens can be used to give soldiers a near 360-degree view of the battlefield. When troops, pilots and sailors are in a vehicle, aircraft or ship, simulation is straightforward and there are simulators for tanks, other Armoured Fighting Vehicles, Ship Bridges, Ship Combat Information Centres (CIC), ship's weapon systems, submarines, and aircraft of all sorts from helicopters, fighters, transports, air-refuellers, and bombers. A significant difference to on-range exercises using real vehicles is that personnel can be in simulators at home bases and still participate in a multi-role exercise using real-time network links with other simulators at different bases. Exercise Control (ExCon) can be at yet another base such as a military HQ, and such exercises can vary from relatively simple for basic land/sea/air training, to highly complex with challenging scenarios, the potential to add some instrumented live assets to the overall exercise, and the involvement of other services and other nations.

Screen-based trainers from Meggitt Training Systems



Furthermore, unlike training that uses the real equipment, simulation is almost infinitely versatile and can be used to explore scenarios that are simply not possible or too hazardous to enact with real hardware. After different scenarios have been simulated, it is then possible to recommend optimum responses to different threats. This requires that the standard and fidelity of modern military simulation must be of the highest, and resources should not be withheld in the training and simulation area, as used to happen in the past. The era when some people deliberately denied the use of state-of-the-art simulation on grounds either of "economy" or as a deliberate attempt to keep more training on the real equipment, should have gone. In any case, more training on good-quality simulators means that the service life of the real equipment can be prolonged, not prematurely worn out by over-use in constant live training exercises when viable training alternatives exist. Indeed, after an optimum course of action has been found through simulation, it can then be tried in live exercises and either confirmed or refined, maybe after further sequences of simulation and live exercises.

Conclusion

Land, sea and air ranges play a vital part in army, navy and air force training. They can be used not only for live weapon firing but also where lasers are used instead of live rounds, and in some cases no firing at all because weapon effects can be computer-generated and used in After Action Review. Pure simulation can also be used, not only for routine training but also to explore options and alternatives, the effectiveness of which can then be confirmed in realistic on-range exercises. ■

Virtual and Augmented Reality in Training Applications

William Carter

The internet and news media are full of terms that are freely used without being properly defined. Examples include Virtual Reality (VR) and Augmented Reality (AR). In the same subject area you will also find "mixed reality" and "hybrid reality", even the term "computer-mediated reality". Wikipedia says that "Virtual reality is an interactive computer-generated experience within a simulated environment that incorporates auditory, visual, and other types of sensory feedback". In this modern digital age, Wikipedia is probably as good a source on factual matters as traditional dictionaries and encyclopædias such as Websters, the Oxford English Dictionary (OED), Encyclopædia Britannica and so forth. Wiki also says that Augmented Reality (AR) is where the real-world is added to by computer-generated information, and states that mixed reality, hybrid reality and computer-mediated reality mean essentially the same as AR. Turning now to the simulation and training area, terminology is generally easier to understand. For instance, civil Full Flight Simulators (FFS) and military Full Mission Simulators (FMS) are close replicas of the cockpit of the aircraft to be trained, its controls, visual and audio cues, and all civil FFS have 6-axis motion that moves the cockpit so that the crew experience similar motion cues to those in the real aircraft. Some military FFS have 6-axis motion; others have enormous visual systems that give a realistic picture of the outside-world scene wherever you look. Such training devices are independent of the real equipment and this is the essence of a "virtual" system. Army field exercises, naval exercises at sea, and airborne combat exercises often use computerised scenarios that include simulated (therefore "virtual") opponents, lasers may be used instead of live rounds, and other enhancements are made to the real world situation. These come under the definition of "Augmented Reality" because these training systems mix real-world and simulated data. However, the use of the term AR is rather academic compared to more precise descriptions of the systems actually used in the particular exercise or training system.

Photo: CAE

A 700MR Series fixed-base flight training device (FTD) for the NH90 helicopter developed by the Canadian company CAE

It used to be considered that the only realistic training was that which used the real aircraft, ships, tanks and other real weapons which were fired using either live rounds or blanks. Simulations were considered to be a useful preparation for operating the real equipment, and were particularly useful for familiarisation with more complex equipment including functions such as checks, procedures and emergencies. However, the inexorable march of computer power, computer graphics, plus linking of training aids for multi-unit, multi-location, multi-role and multi-national training (so-called "networking"), has reversed the relative importance of training in a real environment, in favour of "the virtual" in many areas of training. Naturally, both real and virtual training are needed. For an efficient modern training system, the use of real equipment and virtual simulations are complementary, and the ratio of real-to-virtual depends on the type of equipment and personnel involved, and the object of the training. An important factor in this modern electronic age is that if real equipment is used to the full in a training mode, a potential enemy can see how it is being used, can note details such as guidance modes, transmission protocols and frequencies. The potential enemy then has the information to prepare countermeasures. Furthermore, with some long range weapons, there may not be enough range airspace in which to use the real weapon to its full capability, particularly in the crowded skies of Europe. All of these factors show why more military training uses simulation technology and less uses the real equipment, therefore preserving it for use in a conflict situation and prolonging its service life because it is not fatigued by constant use in a training mode.

The major use of simulation in training is probably in the air domain, in which the ratio of simulator-to aircraft training has reached 70:30 in some areas, although 50:50 is more common. Simulation can do more types of training than can be flown in the aircraft. Also, it is several times less expensive than using the aircraft, and is not prone to accidents that can write-off aircraft and kill aircrew in critical training sorties. In other words, it is better to make mistakes in a flight simulator than in the aircraft itself. Then there is the potential to use network links between different units, forces and nations, for combined training.

Photo: CAE

Full flight simulators for the P-8A POSEIDON maritime surveillance aircraft built by CAE

Similar principles apply to complex military equipment such as ships from landing craft up to aircraft carriers, armoured fighting vehicles (AFVs), artillery pieces, and other army vehicles. The difficult area in applying simulation technology is in training the infantry soldier. You can hardly put an infantry platoon in a simulator in the same way as aircrew in an aircraft simulator or navy crew in a ship's bridge simulator or a simulator for a ship's combat operations centre. Improved infantry training using modern virtual technology was asked for by Marine General James Mattis (now US Secretary of Defense) at the International and Industry Training, Simulation and Education Conference (I/ITSEC) in Orlando, USA, as long ago as 2009. There is no easy answer to this question. Infantry must train on the ground as individuals, in platoons and companies. They are not in an environment such as an aircraft cockpit or a ship's bridge or combat centre that is easy to reproduce in a simulator. However, in field exercises, soldiers can fire lasers rather than bullets, and this has major advantages. Laser pulses can be coded so that for debrief purposes the individual firer can be identified, whether it be a soldier, tank gun, artillery piece, helicopter, other aircraft, even ship gunfire in coastal (so-called "littoral") warfare. When this is combined with using GPS to record the accurate time and location of fire and manoeuvre of individual soldiers and other entities, you have the basis for in-depth After Action Review (AAR) based on fact rather than opinion (which often used to prejudice AAR in the past). Indeed, I would suggest that sophisticated AAR using modern technology is the most important development in military training since field exercises were first employed in ancient times by empires such as the Egyptians, Romans and Carthaginians. This included training for the Egyptians' horse-drawn war chariots, the Romans training their shield-wall "Testudo" formations, and Hannibal training his phalanxes of war elephants. In modern training, the difference is not so much in the exercise, it is in the post-exercise debrief that can, and should, take more time than the exercise itself, to fully exploit the information that is now available from recording of weapons, soldiers, vehicles, aircraft and ships during the exercise.

To emphasise the principles of modern virtual/simulation technology, what follows is a selection of recent training programmes in the land, sea and air areas that use the systems discussed above. Within each section, entries are in alphabetical order of country and include Australia, Belgium, Canada, Germany, Italy, New Zealand, Norway, Sweden, Taiwan, UK, Ukraine and the USA. In the air force group, as well as conventional simulators, there are also two high-G man-rated centrifuge systems for familiarising fighter aircrew with conditions up to 9 times the normal pull of gravity, so as to reduce the possibility that they will not "black out" in real high-G combat.

Air Force Systems

Australia: Boeing Defence Australia (BDA), headquartered in Sydney, is prime contractor for a new training facility being built at the Royal Australian Air Force (RAAF) Base Edinburgh. A CAE-built full flight simulator for the P-8A POSEIDON maritime surveillance aircraft has just been installed. The facility will deliver about 40 different courses for the P-8A.

Germany: CAE Elektronik of Stolberg is to provide aircrew training systems and services to Boeing for the H-47 CHINOOK helicopter being offered for the German Air Force heavy-lift helicopter competition.

Italy: Leonardo headquartered in Rome has provided its Realistic Intelligent Agent Computer Environment (RIACE) system to the Italian Air Force. This is a distributed training system that generates realistic operational scenarios for pilots at different bases. It includes aircraft such as the EUROFIGHTER, TORNADO, ALENIA M-346 Master and the PREDATOR UAV. Other functions can be added such as those for Joint Terminal Attack Controllers (JTAC), missile-defence and command and control systems. Systems at the integration test bed at Pratica di Mare Air Base can also be incorporated.

New Zealand: CAE, headquartered in Montreal, Canada, is to deliver a 700MR Series fixed-base flight training device (FTD) for the NH90 helicopter to RNZAF Base Ohakea on the west coast of North Island. Maintenance and support will be included and the total value is over CAN$50M. CAE launched its 700 Mission Reality (MR) Series FTD at the UK Farnborough air show in July. The RNZAF NH90 FTD will have the CAE Medallion-6000XR image generator, a 240x88 degree display, and a dynamic seat for vibration and some motion cueing.

Taiwan: FAAC Incorporated of Ann Arbor, Michigan, USA, has a three-year, US$1.9M contract for the Taiwan Training Range.

Photo: FSI

A flight simulator for the Boeing C-17 GLOBEMASTER III aircraft developed by FlightSafety International (FSI)

FAAC will deliver SimBuilder simulation software, new weapon models, on-site training and support. SimBuilder models weapons and integrated air defence systems and will be applied to the existing Air Combat Environment for Testing and Training (FACETT) system. SimBuilder has modules for air-to-air, surface-to-air, surface-to-surface, and air-to-surface environments.

UK: L3 Commercial Training Solutions (L3 CTS), headquartered at Crawley, is to provide multi-engine courses for Royal Air Force pilots after initial flight training. There will be an introduction course followed by Multi-Crew Cooperation (MCC) training using flight simulators at the L3 UK Academy. This training is similar to a Commercial Pilot License (CPL) with Instrument Rating (IR).

Photo: FSI

The inside of an FSI C-17 simulator

US Air Force

US AF and Australia: FlightSafety International (FSI) Simulation, headquartered at Broken Arrow, Oklahoma, is to supply aircrew training systems for the Boeing C-17 GLOBEMASTER III transport aircraft under a contract with Boeing. This will be for 15 USAF Air Mobility Command locations and the Royal Australian Air Force Base in Amberley.

US AF – Centrifuge for Aircrew Training: Environmental Tectonics Corporation (ETC), headquartered in Philadelphia, has achieved full operational capability for a human-rated centrifuge at the US Air Force Research Laboratory (AFRL), Wright-Patterson Air Force Base, Ohio. This enables training up to 9G with the object of preventing G-induced loss of consciousness (G-LOC) when operating fighter aircraft.

US AF – Distributed Mission Operations: QuantaDyn Corporation of Herndon, Virginia, has delivered its Joint Terminal Control (JTC) Training and Rehearsal System (TRS) to the Distributed Mission Operations Center (DMOC) at Kirtland Air Force Base, New Mexico.

Air Control Systems

Australian Forces: Advanced Simulation Technology Inc. of Herndon, Washington DC, will provide new features for its Simulated Environment for Realistic ATC (SERA) product for Lockheed Martin's AIR 5428 Pilot Training System for the Australian Air Force, Navy and Army.

Norway: Fidelity Technologies Corporation, of Reading, USA, has delivered its Joint Fires Advanced Training System (JFATS) simulator to the Norwegian Defence Material Agency's (NDMA) Air Ground Operations School (AGOS). This has a 7 metre dome display and is used for Joint Terminal Attack Controller (JTAC) and Joint Fires Observer (JFO) training of four-man Tactical Air Control Parties (TACP).

US Army: UFA, Inc., of Burlington, Massachusetts, has delivered its ATTower simulator to Libby Airfield, Arizona. This has four visual channels for visual control and a Fixed Based Precision Approach Radar (FBPAR) system for instrument approaches.

US Marine Corps: Riptide Software Inc, of Oviedo, Florida, has a contract from the US Marine Corps for the Supporting Arms Virtual Trainer (SAVT). SAVT is for training Joint Terminal Attack Controllers (JTAC), Forward Observers (FO), and Forward Air Controllers (FAC), in Close Air Support (CAS) operations. SAVT training systems are at 6 locations in mainland USA and at the Marine Corps Base Kaneohe, Hawaii.

Photo: KBRwyle

KBRwyle's man-rated pilot centrifuge for high-G sessions

Multi-Role Systems

Sweden: 4C Strategies, headquartered in Stockholm, launched Exonaut Simulation Extension (ESE), that enables Exonaut exercise management tools to interact with simulators and C^2 systems. It provides a configurable interface for simulation environments, allows plug-in adaptors for different types of simulators, and records training data. ESE was used on exercise Viking 18 in April 2018.

Ukraine: The US Department of Defense is to provide Ukraine forces with US$200M training, equipment and advisory services. This will include command & control systems, secure communications, mobility and night vision aids, and military medical systems.

Army Systems

Belgium: MASA Group, headquartered in Paris, has supplied their SWORD war gaming system to the Belgian Army simulation centre in Limburg for command-post training at company and battalion levels. At Limburg, SWORD works with the Virtual Battlespace 3 (VBS3) system from Bohemia Interactive Simulations for further training.
Canada: Cubic Global Defense, headquartered in San Diego, California, has a US$27M contract to deliver Urban Operations Training Systems (UOTS) to Canadian Forces Base (CFB) Gagetown and the Canadian Manoeuvre Training Centre (CMTC) Wainwright. This is part of the Canadian Weapon Effects Simulation (CWES) programme. UOTS includes a tracking system; shoot-through-wall capability; special effects including smoke, smell, light, sound; plus improvised explosive device (IED) and grenade simulators. Completion is scheduled for CFB Gagetown in October 2019 and CMTC Wainwright in September 2020.
USA – Missile Defence: Charles River Analytics Inc (CRA), of Cambridge, Massachusetts, has a US$1M contract from the US Missile Defense Agency (MDA) for the company's Modelling Operator Reasoning and Performance for Human-in-Control Simulation (MORPHIC). The MDA will use MORPHIC to create models of human behaviour and CRA will use Hap architecture for behaviour modelling including cyber adversaries, physiological factors and the development of tutoring systems.
USA – Operations Research: MASA Group, headquartered in Paris, France, has supplied MASA SWORD licenses to Parsons Corporation for operations research and evaluation of weapon platforms. The AI-based simulation software provides training and analysis for military and emergency management scenarios. Parsons will use the software for analysis of weapons, sensors, and effects such as weather conditions.
US Army – LVC training: Science Applications International Corporation (SAIC), headquartered in McLean, Virginia, has a US$52M task order to support the Manoeuvre Center of Excellence at the Manoeuvre Battle Lab in Fort Benning, Georgia. SAIC will develop combined arms Live, Virtual and Constructive (LVC) training and game-based systems. These focus on infantry, STRYKER and armour brigade combat teams (BCTs) and reconnaissance formations.
US Army – Simulation and Live Fire: Aptima of Woburn, Massachussetts, has a US$168,000 Other Transaction Authority (OTA) agreement from the US Army to develop a methodology that aligns current Army simulation training systems with live-fire training.

Navy Systems

US Navy – Centrifuge for Aircrew Training: KBRwyle inc, headquartered in Houston, Texas, is to provide annual centrifuge-based training for Navy and Marine Corps aircrew. This will include about 600 aircrew and will include classroom instruction and high-G sessions in the company's man-rated centrifuge. The company performs similar training for Air Force aircrew.
US Navy – Distributed Training: Plexsys Interface Products of Portland, Washington State, is to provide its SonoMarc communications simulation system for the US Navy Aviation Distributed Training Center (NADTC). Up to three NADTC Operation Centers (NOCs) will be delivered to Naval Air Station (NAS) Oceana, Virginia, with options for NAS North Island, California, and Marine Corps Air Station (MCAS) Iwakuni, Japan.
US Navy – Helicopter Training: FlightSafety International (FSI) Simulation, headquartered at Tulsa, Oklahoma, is to supply new training systems for the Bell TH-57 SEA RANGER helicopter for the Navy, Marine Corps and Coast Guard. FlightSafety is the prime contractor for the TH-57 Aircrew Training Services programme and will manage the replacement of the current training devices, deliver instruction and logistics support. The new Level 6 and Level 7 flight training devices, image generators, visual databases and projectors are scheduled to enter service in February 2019.

Photo: UFA

An airport tower simulator at Libby Airfield, Arizona, with four visual control channels and a Fixed Based Precision Approach Radar (FBPAR) system for instrument approaches

US Navy – Missile Training: The US Navy Surface and Mine Warfighting Development Center (SMWDC) has developed a missile exercise (MSLEX) system with about 30 training scenarios. This is designed to counter threats and develop tactics, techniques and procedures (TTPs), pre-planned responses (PPRs) and commanding officer's battle orders.
US Navy – Test Pilot Training: The US Navy Test Pilot School at Naval Air Station Patuxent River, Maryland, has added a simulator for their new Airborne Systems Training and Research Support (ASTARS) III aircraft.

Conclusion

This article shows how the use of modern simulation technology has improved military training in the Land, Sea and Air areas. The trend is for more use of so-called "virtual" training systems which are less expensive than using front-line equipment, and do not wear out or damage the real equipment by constant use in training. In addition, in areas except perhaps infantry training, simulation can be used to produce more scenarios that are not possible when the real equipment is used. ■

What Lies Beneath

Land Mine Detection and Clearance

Bindiya Carmeline Thomas

The ramifications of recent global conflicts have resulted in the marked rise in land mine casualties, undoing years of demining and clearance efforts. According to the Landmine Monitor 2017, armed conflict in Afghanistan, Libya, Ukraine, and Yemen contributed to the second year of exceptionally high casualties caused by mines, including improvised devices that are triggered like mines, and other explosive remnants of war (ERW).

Photo: Northrop Grumman

The US Navy favours Northrop Grumman's Advanced Explosive Ordnance Disposal Robotic System (AEODRS) for demining missions.

The Landmine Monitor recorded 8,605 mine/ERW casualties, of which at least 2,089 people were killed in 2016. "Following a sharp increase in 2015, the casualty total in 2016 marked the highest number of annually recorded casualties in Monitor data since 1999 (9,228), the most child casualties ever recorded, and the highest number of annual casualties caused by improvised mines. Despite being weapons of war, mines/ERW mostly kill and injure civilians, who made up 78% of all recorded casualties in 2016, similar to past years," according to the press release.

Although the production and distribution of land mines effectively ended two decades ago with the enforcement of the Mine Ban Treaty beginning in 1997, there are an estimated 110 million land mines in the ground right now with an equal amount in stockpiles in over 60 countries waiting to be planted or destroyed.

With resounding calls to increase detection and clearance to safeguard human life and the ecosystem, the development of mine clearance technology is on the upswing.

In 2016, the Global Mine Clearance System Market was valued at US$32.9M and is projected to reach US$52.2M by 2025, exhibiting a CAGR of 5.29% over the forecast period, according to a study published by Coherent Market Insights. "Europe held the largest mine clearance system market share accounting for over 41% of the industry in 2016 and is expected to dominate the industry over the forecast period. The prominent factor responsible for high adoption is the massive extent of explosive-contaminated areas in countries such as Croatia, Turkey, UK, and Ukraine," the study added.

Author

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Mine Clearance Vehicles

The Russian military operates a bevy of mine clearing vehicles, including the Ural TYPHOON and the Kamaz TYPHOON among others, and has plans to induct more in the future.

According to Russian media reports, in August 2017, Uralvagonzavod (UVZ), a subsidiary of Rostec, delivered a batch of the BMR-3MA heavy mine-clearance vehicles to the Russian Ministry of Defence (MoD). The BMR-3MA is the advanced version of the BMR-3M VEPR (BOAR) armoured clearance vehicle and was developed on the basis of the T-90 MBT (main battle tank); it was "built to collect intelligence, overcome obstacles and perform mine clearance operations,", according to Sputnik News Agency.

In 2015, Iraq reportedly received 400 BMR-3M vehicles as part of a "secret deal" with Russia to clear the mines planted by the Islamic State (IS). "It clears passages of a width approximately equal to the inter-wheel clearance of tanks, infantry fighting vehicles, and armoured personnel carriers. Attached to the front of the vehicle are two arms, each with solid steel wheels that rely on their weight to detonate mines while driving over them; this doesn't damage the tanks due to their thickness, allowing the vehicle to continue along its path with other tanks such as the T-90 following it," the report added.

The US Marine Corps' Assault Breacher Vehicle (ABV) made history last year when it conducted its first amphibious landing with a Modified Full Width Mine Plow prototype during a long-range breaching exercise in the western United States.

In December 2017, Marine Corps Systems Command used Exercise Steel Knight as an opportunity to test the prototype for the first time. Steel Knight is a division-level exercise designed to enhance command and control, and interoperability with the 1st Marine Division, its adjacent units, and naval support forces.

In the future, this piece of equipment will make it easier for Marines to land and deploy an ABV from a Navy Landing Craft Utility boat to the shore to complete their mission.

Once the LCU drops the bow ramp onto land, Marines can drive the ABV off the boat, open the plow and breach the area to ensure they eliminate any unsafe obstacles. After the line charge detonates, land mines in its path are destroyed or rendered ineffective. Marines use the mine plow to sift through the minefield and push any remaining land mines off to the side, leaving a safe path for the assault force.

The ABV Programme Team plans to take the information and feedback from the Marines gathered at Steel Knight to refine the design and improve the overall performance of the modified plow. The team wants to ensure the modified plow will meet all requirements of the legacy mine plow in performance and survivability. After the redesign is completed, the articles will be tested at the US Army Aberdeen Test Centre in Maryland.

Meanwhile, Indian defence manufacturer MKU introduced a range of products at DEFEXPO 2018 in Chennai, India, including the MKU-ABBS AMPS technology to counter the threat of land mines and IEDs. The technology employs the patented VGAM (Vehicle Global Acceleration Mitigation) system. This system works using the patented LRM (Linear Rocket Motor), sensor-based motorised linear rockets, which upon sensing an underbelly blast, fires linear rockets to negate the thrust provided by the VGA, thereby countering and negating the overall upward thrust on the vehicle. To a certain extent, the platform often remains recoverable and can be put back into operation after refurbishment and replenishment. The Active Blast System can easily be retrofitted into legacy in-service vehicles as well as platforms under development, according to a statement from MKU.

Photo: USMC

The US Marine Corps makes history with the mine plow prototype for the Assault Breacher Vehicle (ABV).

Meanwhile, the state-run Defence Research and Development Organisation (DRDO) has undertaken trials of the indigenously developed TRAWL system that could locate mines on the Indian Army's battlefield.

The TRAWL system is used to breach land mines and create a vehicle safe lane through a minefield for the advancing columns of mechanised forces in a combat zone. The equipment consists of the TRAWL roller, a track-width mine plow and an electromagnetic device (EMD). The anti-mine system has components that could detect all type of mines usually encountered by the tanks, the Defence Research Development Organisation (DRDO) said in a statement earlier this year.

Recently, the TRAWL system underwent blast trials which demonstrated the survivability of the equipment when subjected to successive series of blast directly underneath it. The fieldable prototype of the TRAWL system is in the final stage and will shortly be ready for user evaluation trials by the army.

Israel's Urdan Metal & Casting Industries Ltd announced during DEFEXPO 2016 in Goa, India, that it will supply the Israeli Defence Forces with dozens of BACKTRAIL logistic trailer systems.

At DEFEXPO, the company highlighted add-on systems that enhance the usability of MBT, self-propelled & towed guns, and engineering vehicles. Besides BACKTRAIL, add-ons include a bulldozer attachment kit and a mine-clearing roller system. Delivery of the BACKTRAIL systems – following six years of evolving development – has already begun and will continue over the next few years, Urdan said in an official statement.

The Mine Clearing Roller System, attached to the front of the tank, neutralises anti-tank land mines on the surface or buried in the track path, and also clears tilt-rod mines from between the roller banks. Easily connected by standard lifting equipment, two soldiers can couple the system to the tank in a few minutes. Since explosions take place at a distance from the tank, and due to almost 100% effectiveness, the system contributes significantly to the survivability of soldiers in the tank.

"The basic idea of the add-ons is to eliminate the need for additional vehicles – in most cases without armour – being sent to the battlefield. When the tank's crew decides they no longer need the add-on, they can disconnect it from the tank with just a push of a button. Connection to the tank is also extremely fast and easy," the statement added.

Photo: US Navy

The US Marine Corps Systems Command tested the prototype which will make it easier to transport the ABV from ship to shore.

Unmanned Systems

Drones could be used to detect dangerous "butterfly" land mines in remote regions of post-conflict countries, according to new research from Binghamton State University, New York.

Of the estimated 100 million military munitions and explosives around the world, millions of these are surface plastic land mines with low-pressure triggers, such as the mass-produced Soviet PFM-1 "butterfly" land mine.

Photo: US Army

The US Army's HUSKY-mounted IED detection system.

Researchers at Binghamton University have developed a method that allows highly accurate detection of "butterfly" land mines from low-cost commercial drones by using mounted infrared cameras to remotely map the dynamic thermal conditions of the surface and recorded unique thermal signatures associated with the plastic casings of the mines.

During an early-morning experiment, they found that the mines heated up at a much greater rate than surrounding rocks, and they were able to identify the mines by their shape and apparent thermal signature. Results indicate that this methodology holds considerable potential to rapidly identify the presence of surface plastic MECs during early-morning hours when these devices become thermal anomalies relative to surrounding geology. The use of cost- and time-efficient remote sensing techniques to detect plastic MECs such as the butterfly mine from unmanned aerial vehicles have enormous potential that warrants further study, researchers explained.

During a technology demonstration at the US Marine Corps Base Camp Pendleton in June 2017, the Naval Surface Warfare Center (NSWC) unveiled a new way to detect buried and submerged mines. Scientists used an Android tablet showing search data from an unmanned aerial drone they had just flown. The device's screen glowed as a green fluorescent map appeared, splashed with red clusters of varying sizes and shapes indicating the dummy mines they had buried.

The development of the new Mine Warfare Rapid Assessment Capability (MIW RAC) system was sponsored by the US Office of Naval Research's (ONR) TechSolutions programme, MIW RAC consists of a one-pound quadcopter outfitted with an ultra-sensitive magnetometer sensor system to detect mines and provide real-time search data to a handheld Android device. "This technology will help sailors and Marines who are approaching a beachfront to rapidly clear, or at least determine the location of mines or other hazards that are in their way," said ONR Command Master Chief Matt Matteson. "It could potentially save a lot of lives."

MIW RAC is a portable, remote-controlled system that can detect buried or underwater mines during amphibious beach landings. It is designed to help explosive ordnance disposal teams quickly find mines and dangerous metal obstacles within coastal surf zones and shallow water zones. MIW RAC would provide a new, real-time aerial complement to existing underwater mine-detection capabilities.

While the quadcopter and tablet device are available commercially, the heart of MIW RAC is its proprietary magnetometer sensor suite—which has an extensive detection range and uses complex algorithms to differentiate between various types of objects.

The MIW RAC originated in 2015 when the Navy Expeditionary Combat Command (NECC) sent a request to ONR's TechSolutions programme for a portable system that could detect potential hazards in surf zones, be easy for warfighters to use and fit diverse platforms. TechSolutions is ONR's rapid-response science and technology programme that develops prototype technologies to address problems voiced by sailors and Marines, usually within 12-18 months. In 2018, TechSolutions will deliver prototype MIW RACs to NECC's Explosive Ordnance Disposal Group for further testing and evaluation.

Meanwhile, Russia is expected to take delivery of the advanced robotic mine-clearing vehicle known as URAN-6 along with SKARABEI and SFERA later this year.

"The URAN-6 multifunctional robotic vehicle, the SKARABEI remote-controlled inspection robotic system and the SFERA remote-controlled robotic complex have been tested in Syria. Work for their acceptance for service is planned in 2018," Chief of Russia's Engineering Troops Lieutenant-General Yuri Stavitsky was quoted as saying by Tass News Agency.

The URAN-6 can reportedly travel at a speed of up to 15 kph and can be used to neutralise an explosive with the TNT equivalent of 130 lbs. According to various reports, it is capable of manoeuvring through dangerous terrain, search for mines and unexploded ordnance and neutralise them on the operator's command.

Russia's Strategic Missile Forces will also induct 20 LISTVA remote-controlled demining vehicles by 2020. First presented to the general public at the ARMY2018 Military Technical Forum, the remote-controlled mine clearing vehicle has improved survivability and protection when on patrol routes and field positions. It can also clear up routes of vehicles' columns from remotely controlled minefields, radio-controlled mines, and land mines.

The LISTVA remote-controlled demining vehicle was specially developed for the Strategic Missile Forces and has already proved its effectiveness in the course of the command post exercise with the Novosibirsk missile formation. LISTVA's electronic equipment is able to detect mines and land mines up to 100 metres away in a sector of 30 degrees, according to a statement issued by the Russian Ministry of Defence.

By 2020, more than 300 pieces of engineering vehicles will have entered the SMF engineering units. These are obstacle removal vehicles, heavy mechanised bridges, excavators, truck cranes and other engineering means, the statement added.

Israel Aerospace Industries (IAI) is developing a suite of autonomous solutions, including its recently launched ground robotic solutions for Improvised Explosive

Device (IED) detection and route clearing known as SAHAR.

The SAHAR application provides an all-weather, day/night, end-to-end solution tailored to customer requirements, including the robotic platform, the operator control unit and the payloads to detect the IEDs and to control the manipulator as relevant.

SAHAR's autonomous system enables faster and more efficient mission execution, safe operation by eliminating the need of proximity between the operators and the equipment and optimum manoeuvring as per equipment's performance envelope and the specific terrain among others. Such an application usually integrates multiple payloads to detect above-ground / hidden/buried IED's and optional engineering capabilities, such as CIMS (Counter-IED and Counter-Mine Suite, an integrated protection system for the detection of surface and underground IEDs, mines, and roadside bombs), MINDS (the Mines and IED Detection System) for detecting deeply buried objects, and AMMAD (the Anti-Magnetic Mine Actuating Device) which actuates magnetically fused mines prior to the vehicle's entrance into the "kill zone".

"The SAHAR system supports different levels of autonomy that enable the process of route clearance including functions such as environmental terrain mapping, IED detection, road blocks removal and disposal of suspicious IEDs without the risk of the rescue forces. The system is operated from a multi-functional Operator Control Unit (OCU) allowing autonomous mission assignment and control in all weather, light, and darkness around the clock," the company says in a statement.

Photo: Russian MoD

The Russian LISTVA remote-controlled demining vehicle

Radar

Earlier in 2017, Chemring Sensors & Electronic Systems (CSES) won a US$4.9M contract from the US Army for 10 Ground Penetrating Radar (GPR) trial systems that incorporate enhanced technology capabilities. Adding this new detection technology is a continuation of ongoing efforts to enhance the military worth of the successful GPR-based HUSKY-mounted Detection System ("HMDS") programme that was first employed by US forces in Afghanistan in 2008. The high-performance combat-proven VISOR GPR forms the heart of the ruggedised and logistically supportable HMDS. The system employs GPR technology that provides unprecedented performance in the automatic detection, recognition and precision marking of buried metallic and non-metallic threats.

The HMDS GPR technology combines advanced real-time Automatic Target Recognition (ATR) algorithms, integrated GPR and electromagnetic interference (EMI) sensors, global positioning system (GPS), recordable missions for after action review functions and analysis, automatic precision marking, and user-friendly software. It has been ruggedised and designed to be scalable allowing for countries and organisations to adopt the technology to meet their mission requirements, Chemring explains on its website.

Biotechnology

Researchers at the Hebrew University in Israel say that the "major technical challenge in clearing minefields is detecting the mines." Because current detection technology is not vastly different from that used in World War II, researchers believe "there is a critical need for an efficient solution for the remote detection of buried land mines and unexploded ordnance."

Their solution is a rather novel, functional system combining lasers and bacteria to remotely map the location of buried land mines and unexploded ordnance. The system is based on the observation that all land mines leak minute quantities of explosive vapors, which accumulate in the soil above them and serve as markers for their presence. The researchers molecularly engineered live bacteria that emit a fluorescent signal when they come into contact with these vapors. This signal can be recorded and

ESD Spotlight

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quantified from a remote location, according to an official statement. The bacteria were encapsulated in small polymeric beads, which were scattered across the surface of a test field in which real antipersonnel land mines were buried. Using a laser-based scanning system, the test field was remotely scanned and the location of the buried land mines was determined. This appears to be the first demonstration of a functional standoff land mine detection system, the study adds.

"Our field data show that engineered biosensors may be useful in a land mine detection system. For this to be possible, several challenges need to be overcome, such as enhancing the sensitivity and stability of the sensor bacteria, improving scanning speeds to cover large areas, and making the scanning apparatus more compact so it can be used on board a light unmanned aircraft or drone," said Prof. Shimshon Belkin, from the Hebrew University's Alexander Silberman Institute of Life Sciences, who was responsible for genetically engineering the bacterial sensors.

The US Defense Advanced Research Projects Agency (DARPA) is also working on new methods to safely identify land mines or unexploded ordnance left over from past conflicts or testing grounds.

The agency's new Advanced Plant Technologies (APT) programme looks to seemingly simple plants as the next generation of intelligence gatherers. The programme will pursue technologies to engineer robust, plant-based sensors that are self-sustaining in their environment and can be remotely monitored using existing hardware.

DARPA's vision for APT is to harness plants' natural mechanisms for sensing and responding to environmental stimuli and extend them to detect the presence of certain chemicals, pathogens, radiation, and even electromagnetic signals. APT aims to modify the genomes of plants in order to programme in these specific types of sensing and trigger discreet response mechanisms in the presence of relevant stimuli and do so in a way that does not compromise the plants' ability to thrive. If the programme is successful, it will deliver a new sensing platform that is energy independent, robust, stealthy, and easily distributed.

"Plants are highly attuned to their environments and naturally manifest physiological responses to basic stimuli such as light and temperature, but also in some cases to touch, chemicals, pests, and pathogens," said Blake Bextine, the DARPA Programme Manager for APT. "Emerging molecular and modelling techniques may make it possible to reprogramme these detection and reporting capabilities for a wide range of stimuli, which would not only open up new intelligence streams but also reduce the personnel risks and costs associated with traditional sensors."

APT aims to go far beyond current practice, which tends to pursue only a minimal number of modifications. DARPA's goal is to modify multiple and complex traits to give plants new capabilities that enable them to sense and report on numerous stimuli. To succeed, however, the programme must also address how modified plants allocate internal resources and compete in natural environments. Past experiments of this type have reduced the fitness of modified plants by siphoning resources needed to sustain the plants. APT will seek to improve how plants collect and distribute resources and optimise their fitness so that modified plants thrive despite anticipated interactions with natural stressors such as microbes, animals, insects, and other plants, DARPA explains on its website. ■

DVD 2018 – Creativity Needed to Face the Future

Tim Guest

On a shared stage and with poignantly howling storm winds blowing outside, Defence Vehicle Dynamics (DVD) 2018 was held at the UK MOD's leading test and development facility for military equipment, the Millbrook Proving Ground.

The event itself, which showcases advanced technology and innovation that will provide the British Army with vital land power today and into the future, attracted more than 6,000 visitors over its two days. Top military speakers announced key programmes, as nature howled itself hoarse and threatened to blow the event away, as if to make the point that whatever forces man can unleash on man, nature will always have the last word. Managing to raise his mild-mannered voice above the wind, however, keynote speaker and new UK Minister for Procurement, Stuart Andrew MP, did announce the green light on several important UK MoD programmes, despite the tempest. Only weeks in his post, the minister said there was a "need for creativity to face the future", a future, that was one where ISTAR (Intelligence, Surveillance, Target Acquisition, and Reconnaissance) was being increasingly challenged by an ever more sophisticated use of the electromagnetic spectrum by the enemy. He said the deployment of autonomous, remotely-controlled and commercially-sourced systems, such as "drones packed with explosives and sent in swarms", place heavier demands on the individual blue force soldier to cope; this is where Alliance nations need to innovate in order to come up with effective technology to counter and defeat such threats. The good news, however, was that key programmes from AJAX to BOXER, IED robots to CHALLENGER 2, have been injected with a new lease of life at a time of national need.

Stuart Andrew said that as well as the importance of delivering "new" technological solutions to the armed forces, there was also a huge amount of potential left in "re-forming" old and existing technologies, as the re-equipping of WARRIOR and CHALLENGER 2's life-extension programmes highlight, the latter which he said was "proceeding apace". And when it comes to the innovation needed for such future tech and re-vamp programmes, the minister said trying to "inspire young engineers" was a crucial factor. Hence, this year's DVD had, for the very first time, opened its doors to university technical college engineering students from across the UK in the hope of opening their eyes to the exciting possibilities for innovation the defence industry offers. The students took part in interactive activities, including a virtual trialling of the DRAGON RUNNER, the army bomb disposal robot (see below).

Photo: ESD

(L to R:) Sir Simon Bollom, CEO of DE&S, Minister for Defence Procurement Stuart Andrew MP, and Deputy Chief of General Staff, Lieutenant General Nick Pope, sharing the stage at DVD 2018.

BOXER and Other Green Lights

As for the key announcements he made, the minister said that the army now intends to purchase an initial tranche of over 500 BOXER multi-role armoured fighting vehicles, having indicated it would rejoin the programme back in April and having put out its formal RfQ the week before DVD. He said UK suppliers now had the green light to forge ahead with the project, which is expected to provide at least 1,000 jobs in the UK. The lead consortium on the production of the mechanised infantry vehicle (MIV), the Krauss-Maffei Wegmann/Rheinmetall joint venture, Artec as the prime contractor, is now in a position to invite industry to deliver sub-contractor proposals to contribute their specific offerings to the programme. Artec is now expected to

Author

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ramp up work and efforts in order to complete its supplier selection process; it will then return to the UK MoD with a formal proposal in the new year. The British order alone is set to be Artec's biggest single order, which bodes well for the potential opportunities in store for British suppliers and sub-contractors to get involved.

Andrew said that the new 8x8 armoured vehicle is a key part of the British Army's future, adding, "… today marks a big step towards equipping our soldiers with this brand-new troop carrier. I am looking forward to pressing ahead with negotiations in our pursuit of a vehicle, which works best for the Army, the taxpayer and British industry." The MIV requirement is central to the British Army's plans for fast-moving strike brigades. In the original design, development and testing of the BOXER, the UK played a leading role as a key project partner and with the deal now going through all the rights it had to build and export the vehicle from the UK are now set to kick in once again. Indeed, it is understood that commitments have already been made by Artec to UK industry, with partnership agreements signed with a number of UK companies in anticipation of the deal going ahead. The vehicle, which is already in service with the Netherlands, Lithuania and Germany, has a number of systems already supplied and supported by British companies. The UK's first BOXERs are expected to enter service by 2023; the whole involvement of the UK MoD follows comprehensive market analysis of MIVs in service, entering service and in development; this research was focused on the British Army's requirements and how best to deliver them. The results showed that the BOXER was ahead of the field and delivered on agility, capacity, flexibility, protected mobility and utility.

Photo: via author

The UK announced its commitment to procure more than 500 BOXER multi-role armoured fighting vehicles.

AJAX and Bomb Disposal

Stuart Andrew also gave latest details on the AJAX programme, saying that production of the £4.5bn AJAX family of armoured vehicles is now ramping up, with a 2020 in-service date likely. He revealed at DVD that Lockheed Martin UK had successfully delivered the first eight production turrets to General Dynamics Land Systems, the AJAX programme's prime contractor. In all, 245 turrets for the reconnaissance variant of the AJAX fleet are contracted to be manufactured, tested and certified by Lockheed Martin UK. The Defence Minister said, "AJAX is the UK's biggest order of armoured vehicles in a generation, supporting thousands of jobs across the country and modernising our frontline fleet. Having been expertly produced just a few miles away in the same county, it is apt that this first batch of turrets have been delivered in time for Bedfordshire's Army showcase, marking another step towards bringing these vehicles onto the battlefield."

During the event, it was also revealed by the minister that the MoD had recently taken delivery of the 200th Cased Telescope cannon – the innovative weapon, developed between UK and French industry, which will provide the stopping power for the armed AJAX variant, as well as the upgraded WARRIOR vehicle being developed through an MoD Capability Sustainment Programme.

Stuart Andrew also announced that the Army is increasing its autonomous operational capability, with the purchase of 56 Starter Bomb Disposal Robots at a cost of £55M. Using advanced haptic feedback, these robots allow operators to "feel" their way through the intricate process of disarming from a safe distance, protecting UK personnel from threats, such as roadside bombs. The minister said the first two robots had been delivered and that all 56 would be in service by the end of 2020.

CHALLENGER 2

As for the Life Extension Programme (LEP) for the CHALLENGER 2 main battle tank mentioned by the minister, he said that "designs are rapidly maturing" with an "anticipated main gate decision next year". Some 227 MBTs are in line for this upgrade at this time. So far, competitive assessment-phase contracts have seen both Rheinmetall and original CHALLENGER 2 maker, BAE Systems, vie for prime contractor position with the MoD, with that phase closing by year end and both companies' offerings already presented. Two major proposals beyond the scope of the phase include, from Rheinmetall, a 120mm smoothbore gun to replace the existing rifled barrel and from BAE Systems an active protection system, though their affordability may be beyond the MoD's purse. The LEP aims to remove obsolescence from CHALLENGER 2 and extend its out-of-service date by 10 years to 2035. As well as removing obsolescence, there will be the opportunity to make further capability enhancements with the upgraded tank referred to as CHALLENGER 2 Mark 2.

BAE Systems LEP Assessment Phase "Team CHALLENGER 2" consists of: BAE Systems Land (UK), General Dynamics Land Systems-UK, Leonardo, Safran Electronics & Defence, Moog, QinetiQ and General Dynamics Mission Systems-Canada. At DVD, they presented their BLACK NIGHT demonstrator, which sported new sighting, fire control and laser warning systems, and the IRON FIST active protection system from IMI Systems, Israel.

Stuart Andrew also said that the MoD would be introducing a new "Mobile Fires Platform" (MFP) to provide the army with a 155mm artillery capability, though one "embracing 21st century technology and capable of supporting both divisional deep fight and strike".

He also highlighted the repurposing of older equipment citing the Enhanced Palletised Load System (EPLS) - the first vehicle was at DVD – which he said will form the logistic backbone of the British Army, rapidly loading and unloading flatracks, or containers. "We've placed a contract with MAN truck and Bus to convert 382 of our MAN SV vehicles, the workhorse of our fleet, into EPLS," the minister told the DVD audience.

Another key programme Andrew spoke of was for the Next Generation Weapon Locating System (NGWLS), which is set

Photo: Saab

Saab has been commissioned to continue with the logistical support of the British Army's ARTHUR weapon locating system for another year.

to sustain and improve the army's capability to detect, acquire, track and assess current and future land environment indirect fire threats. The NGWLS will comprise systems and sensors intended to replace current in-service Acoustic Sound Ranging Programme (ASP), Lightweight Counter Mortar Radar (LCMR), Mobile Artillery Monitoring Battlefield Radar (MAMBA) and Man-portable Surveillance and Target Acquisition Radar (MSTAR) systems by 2030. (In July, it was announced that Saab had been awarded a one-year contract for the continued logistical support of the ARTHUR MAMBA weapon locating system).

Skipping a Generation to Stay Ahead

Sharing the DVD stage, Sir Simon Bollom, Chief Executive for Defence Equipment and Support (DE&S), a Ministry of Defence affiliated body, said that DVD was an opportunity for the SME community to secure procurement opportunities at a time when the M0D wanted to make the process easier. That said, with an obsolescence cycle of two years in regards to innovation in the data processing sector, Sir Simon said there were risks for all parties getting involved in procurement, whether the MoD, main vendors, or SMEs. But he stressed that the British Army had to maintain a path of "continuous adaptation", equipment had to modernise and a generation of development had to be skipped to stay ahead, a factor AJAX illustrated well. He also stressed that the CHALLENGER 2 Life Extension Programme had enhanced the lethality and survivability of the MBT, and that the Warrior Capability Sustainment Programme had enhanced and upgraded the IFV so that it also now offered improved lethality and survivability, together with latest situational awareness capabilities.

Export Win Footnote

As the premier defence land equipment event in the UK and one of the biggest of its type in the world, DVD 2018 attracted UK companies and partners ranging from SMEs to some of the largest land system suppliers in the defence world. One leading manufacturer marking recent export successes at the show was QinetiQ, which has won two contracts to supply armoured vehicle drive and suspension systems for the US Office of Naval Research. ■

Highly mobile, superbly protected, modular and versatile, the Boxer comes out fighting – the perfect fit for Britain's MIV programme.

FORCE **PROTECTION** IS OUR MISSION.

RHEINMETALL DEFENCE

European Naval Defence Technology for Southeast Asia

Dzirhan Mahadzir

Growing tensions over the South China Sea and competition for resources in the waters of Southeast Asia are forcing countries in the region to modernise their navies. This is why Southeast Asia offers good opportunities for European naval technologies, as demand for ships is growing and obsolete ships are to be replaced.

Although Southeast Asia consists of 11 nations, only 6 of these nations, namely Indonesia, Malaysia, Singapore, Thailand, the Philippines and Vietnam would currently constitute viable naval markets in the region for European companies. The remaining five, Brunei, Cambodia, Laos, Myanmar and Timor-Leste, due to various factors and circumstances can be roughly excluded from being strong potential naval markets. In the case of Brunei, the Royal Brunei Navy's fleet is relatively new; its four DARUSSALAM class OPVs entered service between 2011-2014 and four ITJIHAD class patrol boats entered service in 2010, with both classes built by Germany's Lürssen. As such, coupled with Brunei's manpower limitations, new ship requirements or upgrade requirements for the RBN's ships are not expected to materialise anytime soon. The Royal Cambodian Navy is limited to patrol boats, and there has been little funding and inclination to go beyond that and in any event, Cambodia's close ties to China will anyhow mean that any major naval procurement is highly likely to be sourced from China. Laos is landlocked and thus has no navy, though its army operates small craft capable of river operations. Myanmar is currently under an EU arms embargo and no sales can be made by European companies to it. Finally, Timor-Leste's small size and limited fiscal resources mean it will be unable to make any significant procurement beyond patrol boats.

Photo: Saberwyn

A DARUSSALAM class OPV of the Royal Brunei Navy

The six other nations of Southeast Asia, though, provide strong potential for naval sales for European companies: Indonesia and Malaysia are seeking to replace some of their ageing ships though much will depend on their finances, Singapore will be initiating Multi-Role Combat Vessels and Joint Multi-Mission Ship programmes, the Philippines, while seemingly putting a brake on future warship acquisition is likely to look for upgrades to its GREGORIO DEL PILAR class, Thailand could potentially seek additional ships and Vietnam represents a strong emerging market if it chooses to push itself away from its dependence on Russia for its needs.

One area also to note is that the region is expect to see increased requirements by coastguards for ships capable of patrolling the 200 NM Exclusive Economic Zones (EEZ) in the region, although such ships will not be similarly armed or equipped as warships, the design and capability requirements such as the operation of UAVs from these ships will make naval manufacturers the only capable providers.

It should be noted that in terms of naval sales to the region, there are two distinct aspects to it, one is the sale and construction of the ship or submarine itself while the other aspect is the weapons and combat management systems, sensors and equipment such as engines that are to be installed on new ships or existing ships undergoing an upgrade. Both these aspects in regard to Southeast Asia's naval requirements and the potential for European naval companies will be discussed below.

Author

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Photo: US Navy

US Navy and Singapore Navy ships and submarines gather in formation during the exercise CARAT 2015 in the South China Sea.

Sale/Construction of Ships and Submarines

In general, in regard to the procurement of ships, Southeast Asian countries generally adopt a mix of armament, sensors, systems and equipment from Original Equipment Manufacturers (OEMs) of various nationalities rather than the recommended or stock outfitting by the OEM shipbuilder. To give an example, the Royal Malaysian Navy's MAHARAJA LELA class Littoral Combat Ship is based on Naval Group's GOWIND design and built locally at the Boustead Naval Shipyards at Lumut together with Naval Group. It carries an armament of a single BAE Mk3 57mm gun in a stealth copula, two MSI SEAHAWK 30mm guns, two launchers for the anti-ship Kongsberg Naval Strike Missile (each with four missiles), a 16-cell SYLVER Vertical Launch System for the MBDA MICA surface-to-air missile and two J+S Marine triple torpedo launchers. Its electronic and sensor systems include the Thales Smart-S Mk 2 3D surveillance radar, Rheinmetall TMX/EO Mk 2 fire-control radar, Rheinmetall TMEO Mk 2 electro-optical tracking systems and the Thales CAPTAS Mk 2 variable depth sonar. The Combat Management System is the Naval Group's SETIS system. This type of mix of systems does sometimes make it a challenge for ship manufacturers in regard to integration work on the systems but such is the norm in Southeast Asia where the countries and respective navies show a preference for customising the ship to fit their needs.

One trend emerging also in Southeast Asia is the requirement for indigenous construction rather than overseas construction by the OEM shipbuilder. Indigenous construction has already been the case for ships of patrol boat and fast attack craft size but increasingly this is also now being also the case for larger-sized warships. This is seen in Indonesia's two MARTADINATA class frigates based on the Damen Group's SIGMA design, Malaysia's six MAHARAJA LELA class Littoral Combat Ships (LCS) under construction and six MEKO-100 design KEDAH class Next Generation Patrol Vessels (NGPV) and Thailand's modified BAE RIVER class OPV, HTMS KRABI. However, indigenous construction to some extent still involves the home country facilities of the OEM shipbuilder as often the construction involves ship modules and segments being built by the OEM shipbuilder which are then transported to the indigenous shipbuilder to assemble and build from it. At the same time indigenous construction also involves personnel from the OEM shipbuilder assisting and observing the local shipbuilders during the construction process. To a certain extent, the indigenous construction of ships is more driven by the need to bolster local industry rather than a cost saving or efficiency reason. In an actual sense, construction by the OEM shipbuilder is actually faster and more efficient, for example Malaysia's first GOWIND design MAHARAJA LELA class Littoral Combat Ship whose construction began in 2014 is still under construction, while Egypt's GOWIND corvette EL FATEH was laid down in France in September 2015 and commissioned in September 2017 though subsequent Egyptian GOWIND corvettes will be built in Egypt. Malaysia was given the option by Naval Group to have the first MAHARAJA LELA class ship built in France with the subsequent ones built in Malaysia, but it opted to have all six ships built in-country to bolster the local shipbuilding industry though the result has been a delay from the planned in service date of mid-2019 for the first ship of class.

While indigenous construction is expected to be the norm in the region given in the case of Indonesia, Malaysia, Thailand and Vietnam, an industry capable of naval construction exist though for Singapore, the practicalities of such will be the main consideration, all four of its Type 218SG submarines will be built in Germany in contrast to Indonesia, which is building its third NAGAPASA class submarine in country, with the first two built by Daewoo. Singapore however is expected to build its Multi-Role Combat Vessels and Joint Multi-Mission Ship programmes in-country, though the design may originate from outside Singapore. The Philippines naval shipbuilding industry is fairly limited, so it is more likely that it will opt for construction by the OEM shipbuilder in the OEM's home country rather than indigenous construction.

The potential for submarine purchases in the region appears limited. Although Indonesia is targeting nine additional submarines, it remains to be seen if it can obtain the finances to do so. The Philippines also aims to acquire two submarines, while Malaysia's 15 to 5 naval development plan calls for two additional submarines to add to the two SCORPENE class in service, but it remains to be seen also whether both countries can actually muster the finances for such programmes. Singapore is committed to its four Type 218SG submarines, and its manpower constraints mean that no more additional submarines will be procured until it is time to replace the Type 218SG. Vietnam may be a potential market, but it remains to be seen whether submarine acquisition is a priority and if so, whether Vietnam will eschew its traditional route of obtaining equipment from Russia. Thailand is committed to Chinese submarines though it has recently made proclamation of a mini-submarine programme that it expects to field by 2025.

Photo: Firestorm

The GOWIND design of Naval Group is an export hit in Southeast Asia. The Royal Malaysian Navy's LCS of the MAHARAJA LELA class are based on the GOWIND design.

Equipment

In contrast to indigenous construction for its ships, Southeast Asian nations have continued to depend largely on weapons and combat management systems, sensors and equipment from overseas OEMs rather than local OEMs. This is mainly because such equipment is mostly not fiscally or technologically viable to develop and produce indigenously, particularly in regard to missile systems, though Singapore has pushed development of indigenous combat management systems and sensors. Its INDEPENDENCE class Littoral Mission Vessels incorporate ST Engineering's STELOP 360° panoramic day and night camera package for surveillance and STELOP Compass D electro-optic directors for identifying targets. At the same time, the LMV incorporates a combat information centre, probably using an indigenously developed combat management system. However, a significant portion of the ships' equipment originates from foreign OEMs, such as the weapon systems consisting of MBDA MICA surface to air missiles, an Oto Melara 76mm main gun, a Rafael 25mm TYPHOON gun, two Oto Melara 12.7mm HITROLE gun and two Long-Range Acoustic Device 500 XTREME systems. The ship is powered by two MTU 20 V 4000 M93L diesel engines and its radars consist of a Thales NS100 three-dimensional surveillance radar and Kelvin Hughes SHARPEYE navigation radar. All this shows that despite Singapore being the most technologically advanced Southeast Asian country, it still is dependent upon foreign naval technology for much of its own indigenously built ships, along with expertise – the LMV was jointly designed and developed with Saab Kockums. As such, the other Southeast Asian countries who are less advanced than Singapore also have a similar dependence on foreign OEMs for weapons and combat management systems, sensors and equipment. As mentioned earlier, Southeast Asian countries generally adopt a mix of armament, sensors, systems and equipment from OEMs of various nationalities rather than the recommended or stock outfitting by the OEM shipbuilder with the result that this provides opportunities for companies to become part of a shipbuilding programme, even though they were not part of the winning shipbuilders' recommended equipment for the ship design. An example lies in Malaysia's MAHARAJA LELA class, where it was recommended by local shipbuilders Boustead, while working with Naval Group, that the suitable weapon mix would be the MICA surface-to-air missile and the EXOCET surface-to-surface missile (the later was the same mix that equips Egypt's GOWINDs). This was supported by the Malaysian Government, but the Royal Malaysian Navy pushed for the Raytheon ESSM and Kongsberg Naval Strike Missile with the result that a compromise was reached with the adoption of MICA and the Naval Strike Missile. Thus opportunities exist for companies to supply equipment even though not affiliated with the winning construction or design bidder.

With ships such as Singapore's LMV and Malaysia's under-construction Littoral Mission Ships (LMS) incorporating mission module containers to give flexibility to the ship mission, opportunities exist for manufacturers to provide equipment to equip such mission module containers, though Malaysia's LMS originate from China under a joint agreement, where two will be built by China Shipbuilding and Offshore International Co. Ltd (CSOC) and two will be built by Malaysia's Boustead Naval Shipyard. It remains to be seen whether CSOC will allow third-party countries to provide mission module equipment and whether any third-party country is willing to integrate its equipment with a Chinese origin ship which is likely to employ a Chinese combat management system. Currently in Southeast Asia only Singapore and Malaysia are pursuing the mission module concept so far.

Another avenue of providing weapons and combat management systems, sensors and equipment lies in upgrading in-service ships or second hand ships being transferred to a Southeast Asian nation. The latter, however, is becoming rare because, as a whole, the preference for Southeast Asian navies is to obtain new ships constructed indigenously rather than second-hand ships, though the Philippines may be the sole exception to this given its fiscal constraints. There are possibilities for upgrades to in-service ships in the region though again this depends on the budgets available. The Royal Malaysian Navy does have plans to upgrade its KEDAH class NGPVs with surface-to-surface and surface-to-air missiles though this has yet to be formalised into a

requirement. The Philippines also plans to upgrade its GREGORIO DEL PILAR class in terms of both sensors and weapon systems in the form of surface to surface-to-surface and surface-to-air missiles.

The use of Unmanned Air Vehicles and Unmanned Surface Vessels is starting to gain traction in Southeast Asian Navies, Singapore as always is leading the way with a mix of foreign and indigenous UAVs and USVs being employed by its navy and its planned Multi-Role Combat Vessels is to carry both UAVs and USVs as part of its complement. Both Malaysia and Indonesia are looking at the possibilities of operating UAVs from their ships. Originally Malaysia's MAHARAJA LELA class LCS were to incorporate a UAV control centre allowing UAVs to be operated by the ships, but this was cancelled in order to keep the cost low. Both Malaysia and Indonesia are pursuing limited research and development on UAVs and USVs, but the technological difficulties of developing such indigenously means that foreign OEM UAVs and USVs are more likely to be the choice if a procurement programme is initiated. Nonetheless, it has to be borne in mind that the navies of both countries are more focused upon directing their funding priorities towards the acquisition of ships.

Competition to European Naval Technologies

Looking beyond the countries within Europe itself, competitors for the provision of naval technologies to Southeast Asia include the United States, Russia, China, the Republic of Korea and Israel. The competition does, however, vary in regard to shipbuilding and equipment type. In the case of the United States, there has been actually limited use of US technologies in most navies in the region, due to a combination of restrictions on its high-end combat systems and sensor technology and cost factors. The Philippines, Singapore and Thailand, which all have a history of close military cooperation with the United States, are the main users of US naval technologies. But even within Thailand and Singapore, the scale of US sourced naval technologies is small compared to that sourced from Europe. US shipbuilders have made little headway in the region, though that could due to a preference to focus on the US and Middle East market. Both Malaysia and Indonesia largely eschew US naval technologies, as mentioned earlier, the Royal Malaysian Navy unsuccessfully pushed for the Raytheon ESSM to equip its MAHARAJA LELA class LCS.

Russia maintains a strong position, with regard to fulfilling Vietnamese naval requirements but beyond that has made little headway in supplying the region. A one-off sale of YAKHONT anti-ship missiles took place around 2010, but these only equipped one ship, the frigate KRI OSWALD SIAHAAN, and no further sales have occurred. Russia has been strongly marketing naval technologies to Malaysia, but there has been little interest. China's position is somewhat better. The Indonesian Navy uses the C802 and C705 surface-to-surface missile and China is set to supply Thailand with submarines along with having a joint programme to build the Littoral Mission Ship for Malaysia. As a whole, China's position in providing naval technologies to Southeast Asia faces its own limitations. While the Philippines' President Rodrigo Duterte leans towards China, his military does not and thus there is little potential for China to sell to the Philippines while Singapore has no interest in Chinese military equipment. Vietnam's contesting claims with China in the South China Sea has the result of ensuring Vietnam will not purchase Chinese military equipment and even in Malaysia, there is the possibility that the current government which took over in May this year may be unwilling to push for further military purchases from China, in contrast to the previous government which initiated the LMS programme.

The Republic of Korea has emerged as a strong competitor in recent times. DSME has built two NAGAPASA class submarines for Indonesia along with assisting Indonesia to build the third, and currently is also building a DW-3000 frigate for Thailand, with a second one to be built in Thailand. Meanwhile HHI of the ROK is building two HDF-3000 frigates for the Philippines and possibly a corvette down the line. Israel has a strong foothold in Singapore with its TYPHOON weapons systems mounted on Republic of Singapore Navy (RSN) ships and the PROTECTOR USV being employed and is slowly establishing a foothold in the Philippines with the employment of SPIKE-ER missiles on the Philippines' Multi-Purpose Attack Craft (M-PAC) and the Elbit Systems ELISRA NS9300A Electronic Support Measure (ESM) equipping the two HDF-3000 frigates. Political and religious considerations over Israel in Muslim majority Malaysia and Indonesia, however, mean Israel will be unable to make any sales to the two countries.

Photo: US Navy

The MARTADINATA class frigates of the Indonesian Navy are based on Damen's SIGMA design.

Conclusion

Overall, Southeast Asia provides strong opportunities for European naval technologies, with continuing needs for ships to replace ageing and obsolete ships and upgrades to existing ships capable of additional service. Growing tensions over the South China Sea and competition for resources in the waters of Southeast Asia is also likely to result in naval expansion and modernisation. While indigenous construction is gaining widespread use, the technological and industrial base limitations for Southeast Asian countries in regard to weapon systems, combat management systems, sensors and equipment will continue to ensure that European naval technologies will be required by Southeast Asia to meet its naval needs. ■

"We are investing heavily in research and development"

Interview with İsmail Başyiğit, CEO of MilSOFT

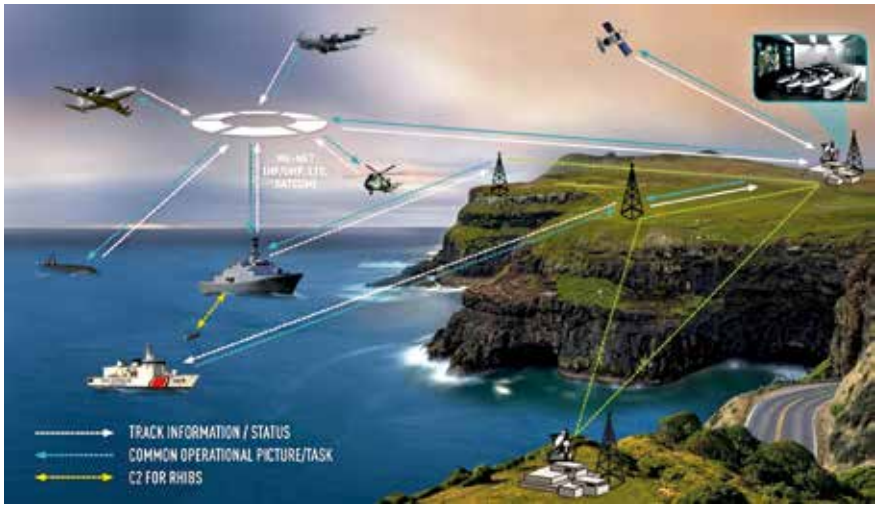
ESD: Mr Başyiğit, can you give us some brief information about MilSOFT?
Başyiğit: MilSOFT was founded in 1998 with the goal of developing high-quality software for the defence industry and to develop technologies that would enable the company to be independent. MilSOFT wanted to be competitive in global markets, which required an effective management infrastructure within the company. In the first two years, our goal was to establish high quality and development methods to be competitive in the global marketplace. And the rest was marketing of what we did. In addition to the NATO certifications, MilSOFT was the first in Turkey to be certified to CMMI Level 3 in 2002. Of course, we have not stopped striving for excellence and in 2005 we were the first CMMI Level 5 company in Europe and Turkey.

ESD: What can you say about your products?
Başyiğit: One of MilSOFT's core competencies is management and control systems in every respect. We try to be part of every step in the Observe, Orient, Decide and Act loop. We have developed our own OACE/DDS compliant infrastructure and management systems. As our readers already know, Open Architecture is a turning point and a technology of the future. We delivered the entire Combat Management System (CMS) software for the search and rescue vessels of the Turkish Coast Guard. Our success in this CMS project was recognised with the Technological Success Award. Thanks to our powerful, scalable and modular CMS infrastructure, we were able to develop a very sophisticated Naval Information Exchange System (NIXS) for the Pakistan Navy in less than a year. This solution is currently being extended to many nodal points, so that the solution is not only used by naval vessels, but also by naval aircraft and command centres.
Another core competence of the company is the development of tactical data links. We have developed Link 11 and 16, which operate on eight PERRY class Turkish frigates and two MİLGEM corvettes and several others. MilSOFT also provided command control functions directly linked to tactical data linking processes. MilSOFT also provides tactical data link solutions from new submarines to aircraft for modernisation programmes. MilSOFT's data connectivity solutions currently run on more than 60 platforms.
MilSOFT has achieved the level of offering indigenous, bespoke data connectivity capabilities no less powerful than the Link 22 or 16 family known today, to meet the needs of our future partners. MilSOFT can also offer data forwarding capabilities not many companies in the world can provide. While being in the military decision cycle, it was impossible to stay away from ad hoc IP-based communication infrastructures which we can also provide even for legacy radios.
We are also providing image analysis capabilities and ground control stations for various UAVs, including the Turkish ANKA UAVs. Nowadays, our image exploitation and analysis capabilities are so advanced that we are considering exporting them to friendly countries.
MilSOFT offers many products and solutions in the field of EW, modelling and simulation, such as avionics-based flight readiness test and post-simulation analysis. More than 2,000 electronic warfare officers of the Turkish Armed Forces have been trained with our electronic warfare simula-

Photos: MilSOFT

Screenshot of MiLSOFT's Combat Management System (CMS) software for the search and rescue vessels of the Turkish Coast Guard

The second goal of the company was to develop domestic technologies that would meet the future requirements of the global market. Since then we have been able to provide our partners with the latest technologies with the support of TÜBITAK (Scientific and Technological Research Council of Turkey).



MiLSOFT's Naval Information Exchange System (NIXS) for the Pakistan Navy

tion suite. Our experience in modelling and simulation also offers test environments for similar systems, such as Data Link Testing.
In addition to intelligence and decision making cycles, MilSOFT also offers embedded software solutions. Some examples are FAA-certified Sikorsky S-92 Mission Computer, Automatic Train Protection Software or the implementation of FACE as an important avionics infrastructure in our national projects.
We know that with such a broad spectrum of solutions, something would be lost if we were not investing in IT middleware. TURKUAZ combines the Enterprise Service Middleware and the Realtime Information Providing Middleware (like the DDS developed by MilSOFT). As you may suspect, we can be a full-service provider or help our partners build their own infrastructure.
In today's military environment, I believe that software will be crucial to winning wars. That is why we are investing heavily in research and development and trying to determine the industry's future requirements.
In terms of technology, quality and price, we are very competitive internationally. The only thing missing is the ability to reach the end consumers and let them know about us.

ESD: You are also exhibiting at IDEAS 2018 in Pakistan. How do you assess the Pakistani defence market and what do you consider to be the challenges for companies?
Başyiğit: We see no difference between the Pakistani and Turkish defence industries. We want to play our part in strengthening the close and well-established partnership. The challenges are the same as in any other country, such as demanding partners and commitments which we are happy to meet.

The questions were asked by Korhan Özkilinc.

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European Naval Suppliers in South America

Bob Nugent

This article draws on AMI's naval market reporting and proprietary data to review South America's naval market, and the prospects for European naval suppliers in it.

Europe has maintained close relationships with South American navies from their very beginnings in the early 19th century. European companies have remained prominent suppliers to those navies in the 20th century, especially in the post WWII period. of European suppliers are having success in the regional market, as seen by France's Naval Group (submarine programmes in Chile and Brazil). Germany's Fassmer has proved attractive is supplying OPV designs and construction assistance (Chile, Colombia).

Photo: DCNS

Naval Group (formerly DCNS) is successful in Brazil with its SCORPENE design; the first RIACHUELO class submarine for the Brazilian navy (RIACHUELO S 40) is already being assembled.

The long-standing preference for German diesel submarines among many navies in the region, and the historic UK-Chile relationship in surface combatants are illustrations of the long-standing Europe-South America naval connection.

Today, the competition to provide the next generation of naval platforms and systems in South America is intensifying. A wider range of European suppliers are having success in the regional market, as seen by France's Naval Group (submarine programmes in Chile and Brazil). Germany's Fassmer has proved attractive is supplying OPV designs and construction assistance (Chile, Colombia).

At the same time ship designs and systems from countries outside Europe are entering the South American market, notably South Korea's Dae Sun Shipbuilding (Peru LPD programme) and Israel's patrol craft in Argentina. Local shipyards and systems suppliers are also playing a larger role in the continent's naval market, with ASMAR, COTECMAR and others taking the lead on local procurements.

These trends are changing the market dynamics in the region for European suppliers, shifting them from a traditional "build and export" business model to offers for design support, construction teaming, and technical transfer and co-production with local shipyards and systems companies. This article draws on AMI's naval market reporting and proprietary data to review South America's naval market, and the prospects for European naval suppliers in it. It first reviews region-wide trends, then provides more detail on naval construction programmes now underway that feature European suppliers. Finally, it provides a snapshot of the largest and/or nearest-term future programmes (expected to be awarded in the next five years), and which European naval suppliers are vying to win those competitions.

As a non-competitive venture, Brazil's nuclear submarine programme will not be considered in this article.

Market Overview

Latin America is a unique naval market in many respects. First, maritime rivalries and tensions remain relatively low, in contrast to other areas such as the Arabian Gulf and South China Sea. Therefore while the leading (and most expensive) programmes in the region continue to be capable and well-armed submarines and surface combatants, those programmes must justify expensive warfare systems and platforms against competing requirements lower on the naval capability spectrum.

For example, expansive maritime economic zones and economic interests (fisheries, energy resources) drive demand for larger OPVs in many South American countries. The proximity of the continent to the Antarctic and lower latitudes also spurs the need for specialty ships and equipment capable of sustained operations in the icy and stormy waters. Lastly, the riverine environment of Amazonia also generates specific and unique requirements for patrol craft and amphibious lift ships and craft.

Looking at the region's future market (20 years to 2037) by country in the chart below, Brazil continues to lead the region in spending and advanced platform acquisition. Despite a lagging economy and continuing political uncertainty, Brazil represents almost 40% of the region's projected total spending on new naval platforms, and acquisition spending over the next two decades, and almost 20% of future hulls.

Author

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This future spending is concentrated in frigate and submarine programmes.
Perhaps surprisingly, Colombia currently places second in the region for planned naval spending and first in the number of hulls to be acquired. While the country's naval structure still is centred on smaller patrol and amphibious platforms, Colombia has put in place an ambitious plan to acquire submarines, frigates, and corvettes. The three platform types together represent some 80% of planned spending for the country. Colombia has steadily invested in developing local naval design and construction capabilities, and the country's naval plans are beginning to benefit from these investments.
Chile, Ecuador and Peru also remain major markets in South America, each representing roughly 10% of regional planned spending. Each country is forecasted to acquire a new generation of larger frigates and submarines to advance their sea service qualitatively, while maintaining the current size of the fleet.

As noted above, the region's requirement for OPVs remains substantial. Seven of eight countries AMI tracks in South America have OPV programmes in their naval budget. Collectively, the OPV sector represents only 6% of forecasted naval spending in South America, but those programmes amount to almost US$1.5Bn in new ship budgets. And OPVs, being lower cost per hull programmes compared to surface combatants or submarines, have typically enjoyed steadier funding support. So OPVs are a market segment of continuing significant opportunity for European ship designers, builders and system providers.
A cautionary note on these plans is that they depend on each country making a sustained commitment to fund programmes - often stretching over a decade or two. In the past those sustained commitments have tended to be lacking in the region, confronted by economic booms and busts, political rivalries, and competition for defence procurement from other military branches.

Current Programmes

The 2008 award of the Brazilian submarine construction program to France's Naval Group (then DCNS) is considered a major event in the South American naval market from the perspective of European suppliers. While DCNS had enjoyed earlier success in Chile with its SCORPENE submarine design, the scope, level of investment and long-term commitment represented by the agreement in Brazil is considered by some analysts to mark a new model of European naval industry relationships in the South American market.
Other observers are more sceptical that the programme will run on the announced schedule and scope. Political and economic uncertainties in Brazil, cloud the prospects for full realisation of both conventional and nuclear submarine construction programmes, a decade on after the initial award.
Construction continues on the first submarine hulls. In January 2018, the Brazilian

South America Regional Naval Procurement Forecast	Hulls to be acquired 2017-36	New Platform Spend 2017-36 (USD M)	Hulls % of Region Total	Spend % of Region Total	Subs Spend $ USD	Sub % of Country Spend	Frigates & Corvettes Spend $ USD	Frigate & Corvette % of Country Spend	OPV Spend $ USD	OPV % of Country Spend
Brazil	53	9048	23%	37%	3260	36%	3700	41%	300	3%
Colombia	76	3574.6	33%	15%	700	20%	1600	45%	240	7%
Chile	11	3333.8	5%	14%	1000	30%	2000	60%	116	3%
Ecuador	22	2970	10%	12%	1600	54%	1800	61%	150	5%
Peru	23	2952	10%	12%	900	30%	1500	51%	300	10%
Venezuela	11	1055	5%	4%						
Argentina	11	899	5%	4%					200	22%
Uruguay	22	388.5	10%	2%					180	46%
Region Total	**229**	**24220.9**			**7460**	**31%**	**10600**	**44%**	**1486**	**6%**

Country	Programme	Status	Expected Contract Award Date	Total Programme Hulls	Euro Hull Suppliers (Design)	Euro Weapons & Systems Suppliers
Brazil	RIACHUELO (SCORPENE) Class Diesel Electric Submarine (SSK)	In Progress	Underway	4	Naval Group	Naval Group, Thales, Safran
Chile	Coast Guard PILOTO PARDO Class Offshore Patrol Vessel (OPV)	In Progress	Underway	2	Fassmer	Bofors, Oto Melara
Colombia	20 DE JULIO Class Offshore Patrol Vessel (OPV)	In Progress	Underway	1	Fassmer	Bofors, Oto Melara
Venezuela	Damen STAN PATROL 5009 Patrol Boat	In Progress	Underway	2	Damen	Thales

Current programmes of European naval suppliers in South America

Photo: BMT

The VENATOR 110 frigate design offered by BMT for the Colombian Navy's tender in 2020 to replace its ALMIRANTE PADILLA class frigates

Navy (Marinha do Brasil - MdB) and Itaguai Construcoes Navais (ICN) transferred three sections of the first RIACHUELO class submarine (Riachuelo – S 40) from the Steel Structures Manufacturing Unit (UFEM) at Itaguai to the other side of the complex on Madeira Island.

Another watermark in the South American naval market has been Fassmer's success. Here the business model is more limited, model centred on design provision, modernisation and construction assistance. This model has proven successful in both Chile and Colombia with OPV programmes. Should Fassmer emerge a winner in the Argentina OPV programme, it would further reinforce the company's leadership in this "niche" sector.

Future Programmes

Looking at programmes expected to be awarded over the next five years, future frigates will continue to be the highest priority for most European naval suppliers. Argentina's OPV programme, with contract award expected in the next 12 months, is another contested field for Europe's ship and systems offerors. And Chile's submarine programme is expected to see keen competition among French, German, Swedish companies.

Argentina: MALVINAS OPVs

Current Argentine Navy (ARA) planning calls for a total of four Offshore Patrol Vessels (OPVs) to be built under this programme to replace the ARA's three CHERBOKEE, two KING and one OLIVIERI class OPVs that were commissioned from the 1940s through 1981.

The ARA requirements call for an OPV displacing around 1,800 tonnes with a flight deck and hangar to support one medium helicopter. It will be powered by two diesel engines for a top speed of at least 25 knots. The OPVs will be armed with one 57mm or 76mm gun and two 12.7mm machine guns. European competitors assessed as vying for the programme include:

- Lürssen Werft (PV 80 design)
- Navantia (AVANTE design)
- Fassmer (1,800-tonne OPV-80)
- Naval Group (GOWIND series)
- BAE Systems (RIVER class)
- Fincantieri (COMMANDANTE or SIRIOS designs)
- Damen (SIGMA series).

Brazil: TAMANDARÉ Corvette Programme

The TAMANDARÉ corvette programme will procure four hulls to be built in Brazil. In December 2017, Brazil issued a Request for Proposals (RfPs) to 21 potential suppliers for the estimated US$1.6B programme. Nine teams reported submitted proposals in May 2018, among them five European-led groups:

Country	Programme	Status	Expected Contract Award Date	Total Programme Hulls	Competing Euro Hull Suppliers (Design)	Competing Euro Weapons & Systems Suppliers
Argentina	MALVINAS Class Offshore Patrol Vessel (OPV)	Planned	2018	4	Lürssen, Navantia, Fassmer, Naval Group, BAE Systems, Fincantieri, Damen	MBDA, Thales, Leonardo
Brazil	TAMANDARÉ Class Corvette	Planned	2019	4	BAE Systems, ThyssenKrupp Marine Systems, Damen/SAAB, Fincantieri, Naval Group	Thales, Leonardo, Naval Group, ATLAS ELEKTRONIK
Chile	Diesel Electric Submarine (SS)	Planned	2020	2	TKMS, Naval Group, SAAB	Naval Group, ATLAS ELEKTRONIK, SAAB, MBDA, Leonardo
Colombia	Future Frigate	Planned	2022	4	Navantia, Naval Group, BAE Systems, Fincantieri, Damen	Thales, Leonardo, Naval Group, MBDA, ATLAS ELEKTRONIK
Peru	Future Frigate	Planned	2020	4	Navantia, Naval Group, BAE Systems, Fincantieri, Damen	Thales, Leonardo, Naval Group, MBDA, ATLAS ELEKTRONIK

South America's top 5 current and future naval programmes

- BAE Systems/CONSUB Defesa e Tecnologia (Type 31e)
- ThyssenKrupp Marine Systems (TKMS)/ Embraer and Ares Aerospacial e Defesa S.A. (MEKO design)
- Damen/Saab/CONSUB Defesa e Tecnologia (SIGMA 10514 design)
- Fincantieri/Leonardo/Ezute (probably Fincantieri 105-meter corvette design)
- Naval Group/Enseada Industria Naval S.A./Mectron S.A. (Gowind design)

On 15 October 2018 the Brazilian Navy's Programme Management Directorate announced a shortlist of four contenders:

- ÁGUAS AZUIS comprising Embraer, Ares Aerospacial e Defesa and TKMS;
- DAMEN-SAAB TAMANDARÉ partnered with Brazil's CONSUB Defesa e Tecnologia;
- FLV: Fincantieri/Leonardo and Vard partnered with Brazil's Ezute;
- VILLEGAGNON consisting of Naval Group, Enseada Industria Naval and Mectron.

The only known armament selection to date is the Matra BAE Dynamics Alenia (MBDA) Sea Ceptor surface-to-air missiles. AMI estimates that some of the combat and sensor systems will be produced locally as part of teaming and partnership agreements. Companies such as Mectron, Embraer's subsidiary Atech, IpqM/Elebra and IpqM/Esca have been involved in development of Combat Management Systems (CMS), anti-ship missiles (ASMs), electronic warfare (EW) systems and machinery control systems (IMCS).

The programme's planned award has been delayed several months, and the winner is expected to be announced in early 2019.

Photo: Damen

Damen proposes its modular 2nd gen OPV for Argentina's MALVINAS class Offshore Patrol Vessel (OPV) programme.

Colombia: Frigate Programme

The Colombian Navy (Armada Republica de Colombia (ARC)) is expected to issue an international tender in 2020 for up to eight frigates to replace its four ALMIRANTE PADILLA class frigates that were built in the early 1980s. The tender will be for the design and construction assistance of the frigates at Colombia's Science and Technology Corporation for the Development of Naval, Maritime and Riverine Industries (COTECMAR).

Navantia of Spain has positioned for the programme with its November 2014 cooperation agreement with COTECMAR to participate in naval ship construction opportunities throughout South America. AMI assesses that Navantia will propose a frigate based on the AVANTE series, possibly the F 538 frigate design that is also being offered to the Peruvian Navy.

Even though Navantia signed a cooperation agreement with COTECMAR, the frigate competition is still considered open as Naval Group is offering its new 4,000-tonne BELHARRA frigate design (export version of the French Navy's FTI medium sized frigate) and the United Kingdom's BMT Defence Services with Sweden's Saab is offering the VENATOR 110 frigate design. Naval Group opened its own representative's office in Bogotá in March 2017. In 2013, DCNS completed the modernisation effort of the ARC's four PADILLA class corvettes.

Photo: tkms

The MEKO design offered by thyssenkrupp Marine Systems (tkms) for Brazil's TAMANDARÉ programme

This programme represents Colombia's largest and most complex naval procurement since acquiring two Type 209 submarines in the 1970s and the four ALMIRANTE class corvettes in the 1980s. Procurement funding for the ARC is very low and it will take a significant effort at the Ministry of Defence (MoD) level to attain the funding.

As with Argentina's programme, external funding is likely to be required to move the frigate procurement forward. Alternatively, the OPV programme may be extended and expanded as a lower cost alternative to a new complex and costly frigate.

Chile: Submarine Programme

Chile received two SCORPENE (O'HIGGINS class) submarines from France's DCNS in 2005 and 2006. The country's navy has a requirement to replace the other two subs in the fleet: Type 209/1300 THOMSON class submarines. Both will be forty years old in 2024 and are expected to be out of service by then, despite having been refitted and modernised in 2014.

An RFP for the new subs is expected soon and may be released at the upcoming Exponaval event in Valparaiso in December, 2018, marking the 200th Anniversary of the Chilean Navy.

France is assessed as being in the best competitive position to supply the next two submarines to Chile, as an all-SCORPENE fleet would reduce training, maintenance and supply chain costs. That said, European submarine builders ThyssenKrupp Marine Systems (TKMS), Fincantieri, Navantia and Saab Kockums are expected to offer alternatives.

Pricing will be a key issue in this procurement. When the Chilean Navy acquired the first two SCORPENE hulls from the DCNS/Navantia team in 1998, they received a significant price discount. Sources indicated that the European suppliers offered the discounts in an effort to maintain employment at their domestic shipyards. In the 20 years since that procurement, ASMAR has significantly matured as a builder and Chile may seek tech transfer and infrastructure investment terms similar to those seen in Brazil's submarine programme. This requirement could open the competition to other providers willing to match or better Naval Group's terms in these areas. ■

The Austro-Asian Artillery Alternative

Georg Mader

For smaller armies, heavy grenade launchers – such as those with a calibre of 120mm – aree an alternative to classic artillery.

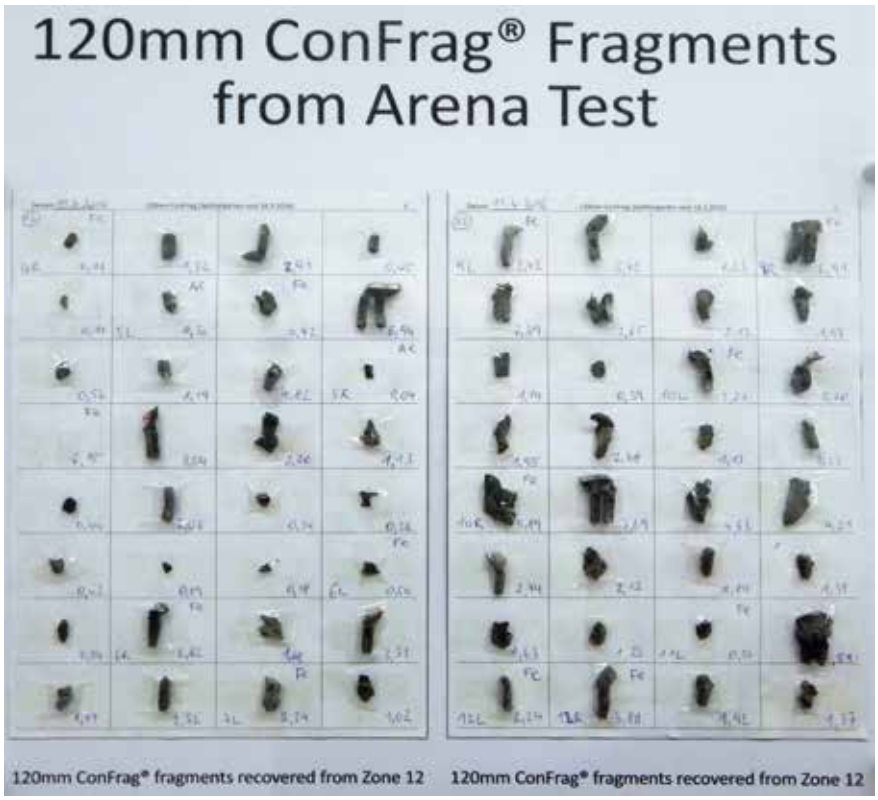
The latter is nowadays almost always self-propelled or a special vehicle, which is why these vehicles take several years to acquire and are much more expensive. Recent combat experiences, for example, from Ukraine, show that quicker position changes are more advantageous than those possible with towed or self-propelled heavy launchers. In the best case, there are only a few minutes left until the opponent returns fire. In June, an innovative niche concept for mobile fire support was presented in Paris, developed by an Austrian company.

Hirtenberger Defence Systems (HDS), recently branding itself as "The Mortar Company", announced at Eurosatory a product-related partnership with ST Engineering from Singapore, centred on their futuristic-looking 120mm automatic launcher SRAMS or 'Super Rapid Advanced Mortar System'. HDS' UK-based subsidiary is to open up the European market, which is otherwise difficult for Asians to access, with an Austria-made fire-control system and three types of ammunition approved in Europe. These include the new high-explosive (HE) CONFRAG Mk.3, with 60% increased splintering effect, or lethality as it is known in the trade, in addition to smoke, light or IR (parachute) grenades. CONFRAG is also offered for the 60mm and 81mm launchers.

The idea behind the cooperation with ST, which celebrated its 50th anniversary in 2017, is that the SRAM's ingenious recoil damping system (reducing recoil to below 26 tons) makes it possible to fire the launcher from many commercially available wheeled or tracked vehicles. According to HDS Vice President for Sales and Marketing Carsten Barth, the launcher can also be retrofitted on 4x4 platforms or Hägglunds-type vehicles as well as all multipurpose 6x6

Photos: Georg Mader

A mortar demonstration at the Austrian Army's firing range in Felixdorf, set up for ST engineers from Singapore in late September 2018



Author

Georg Mader is a defence correspondent and freelance aerospace journalist based in Vienna, Austria, and a regular contributor to ESD.

and 8x8 wheeled or tracked multipurpose vehicles. In contrast to self-propelled artillery, this means that customers do not have to commit a lot of money and logistics on tendering, procuring and operating a new and purpose-built vehicle.

On the other hand, when using a heavier (such as 120mm) system, larger vehicles or more carrier vehicles are required to transport the ammunition. "With CONFRAG, you need less ammunition, and that will change the 120mm mortar market," says Barth. He sees increasing demand from customers who are closely observing market trends for mobile and vehicle-mounted mortar systems and – along with other third-party manufacturers – the recent success of the Rheinmetall/KMW BOXER in Australia and the UK's re-entry into this market.

Prior to the agreement with HDS, the SRAM system already became operational with the Singaporean Armed Forces on the BRONCO All-Terrain Tracked Carrier (ATTC), and in the UAE on the DENEL OMC RG31 Mk.6E mine-protected armoured vehicle (MPV), called the AGRAB (SCORPION) MK2. The UAE bought 46 AGRABs in a 2007 contract then worth US$106M. The 10-tonne vehicle operated by a crew of three carries 46 mortar rounds in two carousels and has two more racks for another 12 rounds. According to video images, the system is being used in the Yemen war, but the ammunition used by the UAE does not come from HDS, but from the local manufacturer "International Golden Group".

The fully electronic fire-control system "Arc Fire" from HDS with components from Rockwell Collins enables the autonomous use of the effector and various applications. The computer-aided fire control automatically takes data from the handheld device of the forward observer – who may be in the field, in another vehicle, or in a helicopter in the future – and marks targets up to 9,000 m away, calculating the ballistic data. It uses a laser target acquisition system, a GPS navigation system and a digital map.

As announced in Paris in spring, HDS has organised live-firings for demonstrational purposes, for instance in late September 2018 at the Austrian Federal Army's firing range in Felixdorf, which would have been difficult to organise for the ST team around chief engineer James Teow Soon NG and General Manager Chor Kiat Tan.

The firing range is only a few kilometres from HDS's headquarters and production site in Triesting valley south of Vienna. This time, military, government and industry representatives from countries such as Germany, Latvia, Estonia and Slovenia, who are potential customers who would otherwise be more difficult for Singaporeans to reach, took part. ESD was also there.

SRAMS SPECIFICATIONS	
Main weapon calibre (mm)	120
Rate of fire (rounds/min)	10
Weight (kg)	1,200
Barrel length, inclusive of blast diffuser (m)	2.1
Firing range (m)	9,000
Elevation (degree)	80
Depression (degree)	40
Traverse arc (degree)	± 40
Loading Sys	Semi-auto
Recoil Force (t)	< 26
First round (sec)	After 60
Crew	3

However, because of rigid safety regulations, only the (blue) training ammunition with a small target marker charge was allowed to be used, expectations regarding the experience of real 'firepower' remained rather unfulfilled. The small grey clouds at different distances were hardly visible. What was well demonstrated, however, was the rapid firing sequence of up to 10 bombs per minute. This is achieved by the rapid mechanism of the loading carriage, which takes only seconds to muzzle-load each round into the 2.1-metre-long mortar tube. ■

The three types of HIRTENBERGER ammunition approved in Europe

The mortar demonstration was organised by HIRTENBERGER.

40th Anniversary of Eletttronica in Germany

(df) Founded in 1978 as a logistic and maintenance facility in support of its Italian parent company Elettronica S.p.A. the German Elettronica GmbH has celebrated the company's 40th anniversary this year. The first contract that the company was awarded by the German Ministry of Defence was for electronic warfare (EW) countermeasures in the scope of the F104 STARFIGHTER programme. Over the years, the company has grown thanks to the participation in international defence programmes like Eurofighter TYPHOON and NH90. During the last decade, Elettronica GmbH successfully entered the new market segments of homeland security and EW simulation. With the acquisition of new capabilities and skills the customer base in Germany and elsewhere could be extended and Elettronica GmbH evolved from a logistics facility to an engineering and systems integration company capable of meeting the requirements of the demanding defence and aerospace markets. "This anniversary today constitutes that our objective set up 40 years ago has been achieved, namely to open the EW gateway to Europe with an innovation-oriented business concept built on a solid Italian foundation with a strong German footprint", Enzo Benini, the President and CEO of the Elettronica Group said in his welcome address. "At the same time, the overarching idea of intensifying industrial cooperation in support of collaboration and integration of the European defence industrial base which, in turn, could constitute the base for the creation of an effective European defence strategy for all Member States, has been pursued." General Axel Binder, the Commander of the Bundeswehr's Strategic Reconnaissance Command, honoured Elettronica's achievements by stating: "Elettronica has proven to be a reliable and valuable partner for the federal armed forces and the Strategic Reconnaissance Command."

Photo: Elettronica

IDE Participates in Diehl's IRIS-T SLM

(df) INTRACOM Defense Electronics (IDE) announced it will extend its cooperation with the German Company Diehl Defence by signing a 5-Year frame contract of €10 million value for the series production of crucial electronic missile components of the IRIS-T SLM (Surface-Launched Medium range) ground-based air defence system. These missile components were developed by IDE and were tested with absolute success during extensive trials in the certification phase of the system. "This new success confirms not only IDE's competitiveness, but also our company's advanced level of expertise in cutting-edge technologies, acknowledged in practice by our international customers", stated George Troullinos, CEO of IDE. At the moment Diehl is equipping the Swedish Army with the IRIS-T SLS short-range air defence system. The SHORAD solution employs the IRIS-T air-to-air missile, operative in Sweden, for vertical launch from the Hägglunds Bv410 carrier platform.

Photo: Diehl Defence

Programme Agreement for German-Norwegian Submarines

(gwh) The Memorandum of Understanding (MoU) on the joint procurement and operation of six identical submarines by the German and Norwegian armed forces was signed on 10 September 2018 by the German defence procurement agency BAAINBw and the Norwegian Defence Materiel Agency (NDMA). This follows a decision of Norway in 2017 to chose Germany as Norway's strategic partner in the submarine area. The partnership covers not only the acquisition of identical submarines, but also cooperation in the training, operation, maintenance and support of the new submarines. Through the programme agreement, Germany has committed itself, among other things, to carry out parts of the planned repair of the submarines in Norway. A future operational organisation will be established by both nations and will be set up in connection with a new maintenance hall in Haakonsvern. The programme agreement is a major milestone on the way to the final offer from the German company thyssenkrupp Marine Systems (tkMS), which was expected by the end of October. Norway has budgeted €4.4bn for its four new submarines.

Photo: NDMA

tkMS Modernises Indian Submarines

(gwh) thyssenkrupp Marine Systems (tkMS) has received an order from Mazagon Dock Shipbuilders (MDL) for the general overhaul and modernisation of the Indian submarine INS SHISHUMAR in the high double-digit million euro range. The contract covers the supply of new equipment, maintenance ofsystems and components, on-site technical support and logistics services in the form of documentation, training and spare parts. It also includes a so-called life certification. With this certificate, thyssenkrupp Marine Systems guarantees functionality of the INS SHISHUMAR pressure vessel for the next decade. The overhaul of INS SHISHUMAR at the MDL shipyard in Mumbai should be completed by 2021. tkMS and its subsidiary ATLAS ELEKTRONIK have been modernising INS SHALKI and INS SHALKUL, two other submarines of the same class, since 2016. The three submarines mentioned belong to a group of four that were put into service between 1986 and 1994. The submarines based on the HDW Class 209 design were built half by HDW (Kiel) and half by MDL (Mumbai).

Malaysian A400M Transport Aircraft Supports Relief Efforts in Indonesia

(ck) The Indonesian Government, the Royal Malaysian Air Force (RMAF) and the Airbus Foundation have been working together to support humanitarian relief efforts in Palu, Indonesia, with the deployment of a RMAF A400M and the distribution of emergency supplies to the city. The A400M, which arrived in Jakarta's Halim Air Base on 4 October 2018, has been delivering relief material to Palu to support the victims of an earth-

quake. The earthquake was followed by a tsunami of up to six metres, which struck the city of Palu and neighbouring Donggala on 28 September. More than 1,400 people have died, around 50,000 residents have

Photo: Airbus

been reported missing and over 200,000 people are in need of emergency assistance. The A400M's cargo included fuel trucks from Indonesian oil firm Pertamina and excavators from industrial products manufacturer PT Pindad. The aircraft also transported food and medical supplies. The Airbus Foundation is also supporting the transport of emergency supplies and is helping the IFRC by providing 45 flight hours with an H125. The Foundation is also supporting Medecins sans Frontières (MSF) by enabling them to contract an H155 operator who will be assisting relief efforts for a few weeks. Furthermore, images from Airbus satellites are being used for emergency response.

Armoured Vehicles for Montenegro

(ck) Germany's parliamentary Secretary of State for Defence, Thomas Silberhorn, handed over six Mercedes-Benz G-Class light armoured patrol vehicles (LAPV) to Montenegro's Chief of General Staff, General Drakutin Dakić, at Golubovci Air Base. The vehicle is known as ENOK in Germany. Its OM 642 diesel engine has an output of 135 kW, a top speed

Photo: Daimler

of around 100 km/h and a range of 700 km. Permissible gross vehicle weight is 6.1 tonnes. Because of its impressive off-road characteristics the vehicle is well-suited for operations in rough conditions. State Secretary Silberhorn reminded those present of the considerable contribution Montenegro is making to NATO by deploying Montenegrin soldiers in ongoing international missions.

ESG and EMT to Collaborate on UAS

(ck) ESG, a leading German provider of security-related IT systems, and EMT, an aeronautical organisation building unmanned air systems, have signed a memorandum of understanding on enhanced collaboration in the tactical UAS field. The collaboration aims to combine the complementary portfolios of EMT and ESG. By realising goal-oriented synergies, the needs of the Bundeswehr and other customers can be better met, from conception and integration to product support for tactical UAS and their mission and ground control systems.

HENSOLDT Consolidates its South African Subsidiaries

(ck) HENSOLDT, a designer of sensor solutions, will consolidate its South African subsidiaries GEW Technologies (Pty) Ltd

Photo: Hensoldt

and HENSOLDT Optronics (Pty) Ltd under the HENSOLDT brand, thus creating a more coherent appearance. GEW Technologies, with approximately 300 employees, is a provider for electronic warfare, spectrum monitoring and security. Founded in 1968, GEW celebrates its 50th anniversary this year. HENSOLDT Optronics South Africa, employing approximately 300 personnel, focuses on the design of specialised optical payloads like the ARGOS and GOSHAWK airborne targeting and surveillance electro-optical systems and associated multispectral sensors, laser rangefinders, and handheld observation systems. Hensoldt Optronics has been in business for more than 45 years.

Spain's Helicopter Simulation Centre

(ck) The CESIHEL helicopter simulation centre is one of the backbones of the Aviation Academy of the Spanish Army (ACAVIET) where pilots of the Spanish Army and Air Force are trained. Developed by Indra, CESIHEL is one of the most advanced simulation centres in Europe, especially in joint tactical training of crews. CESIHEL has eight simulators of different helicopter models connected to a network, allowing training in the most complex mission scenarios. In 2019, two new NH90simulators, also developed by Indra, will enter service at Agoncillo Base. This will bring the network of simulators connected for joint training

Photo: Indra

up to ten devices. The simulation centre comprises flight simulators (FFS) and helicopter trainers for the CH-47D CHINOOK, AS532 COUGAR, EC135 and EC665 TIGER, located at two different bases: Colmenar Viejo, with six simulators, and Almagro, where two simulators for the TIGER helicopter are located. All of them have been developed with Indra technology. Armed forces from around the world are trained at CESIHEL which helps to reduce costs.

Robotic Mine Warfare

(ck) In response to the Belgian-Dutch procurement programme for 12 mine countermeasure vessels, Naval Group and ECA Group want to cooperate on unmanned anti-mine warfare solutions. Naval Group and ECA Group intend to develop military mine warfare vessels (MCMs) that integrate drones, sonars, excavators and remote-controlled systems and robotic mine warfare on board the MCM vessel. The two partners want to combine their most effective solutions, already in use with other customers, to offer a cost-effective solution to the Belgian and Dutch navies. To this end, the two partners have formed a project management team based in Belgium, which will draw on local partners with whom they have already entered into cooperation agreements.

New Director of Operations at Nexter

(ck) Nexter, a KNDS Group company and French leader in land defence, has appointed Sylvain Rousseau as Director of Operations. The group is renewing its management structure to support operational change. Sylvain Rousseau will be responsible for corporate strategy, purchasing and supply chain management at Nexter. His objectives include the successful launch of the export programmes, the improvement of the group's supply chain performance and industrial activities and the implementation of the "make or buy" policy in line with the "Next Performances" progress plan. The "Next Performances" progress plan, launched in 2016 by Stéphane Mayer as President of the Nexter Group, aims to improve the group's performance.

Photo: ESD archive

New Group CEO at Oxley

(ck) Oxley Group has appointed Garry North as CEO of the UK-based Oxley Group of Companies. Oxley Group is a manufacturer of LED lighting systems, night vision solutions and electronic components. The product range includes EMC filters, LED indicator lamps and interconnect products for military and aerospace applications. Oxley is a supplier for major aerospace and defence companies across the globe including Boeing, Sikorsky, General Dynamics, Gulfstream, Lockheed Martin, Korea Aerospace Industries, BAE Systems, Saab and Airbus. Mr. North can draw on his background as a mechanical engineer and has over 40 years of experience in the manufacturing industry, particularly in the aerospace and defence sector. Mr. North has led industry teams in the US, Europe, the Middle and Far East.

Photo: Oxley

MEKO Corvettes Proposed for Brazilian Navy

(ck) The Brazilian Navy announced the shortlist for the CCT (Corvettes Class TAMANDARÉ) programme which seeks to procure four ships. One of the finalists is the consortium Águas Azuis, consisting of thyssenkrupp Marine Systems and Embraer Defense & Security. The two companies have a strong footprint in Brazil and the ability to ensure a transfer of technology also for other Brazilian defence projects. The consortium has proposed a MEKO class design that facilitates local integration and technology transfer and reduces maintenance and modernisation costs. Its robust combat capabilities make the MEKO class an authentic blue water vessel with long range and cost-effective operation. Since 1982, 82 MEKO corvettes have been delivered to 14 different countries, 37 of which have been built outside Germany. All these vessels are still in service, with a service life of more than 40 years. Embraer subsidiary Atech has been chosen to supply the Combat Management System (CMS) for the vessels in close cooperation with thyssenkrupp Marine Systems' ATLAS ELEKTRONIK subsidiary.

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