

# European Security & Defence

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**COUNTRY FOCUS:**  
THE UNITED KINGDOM



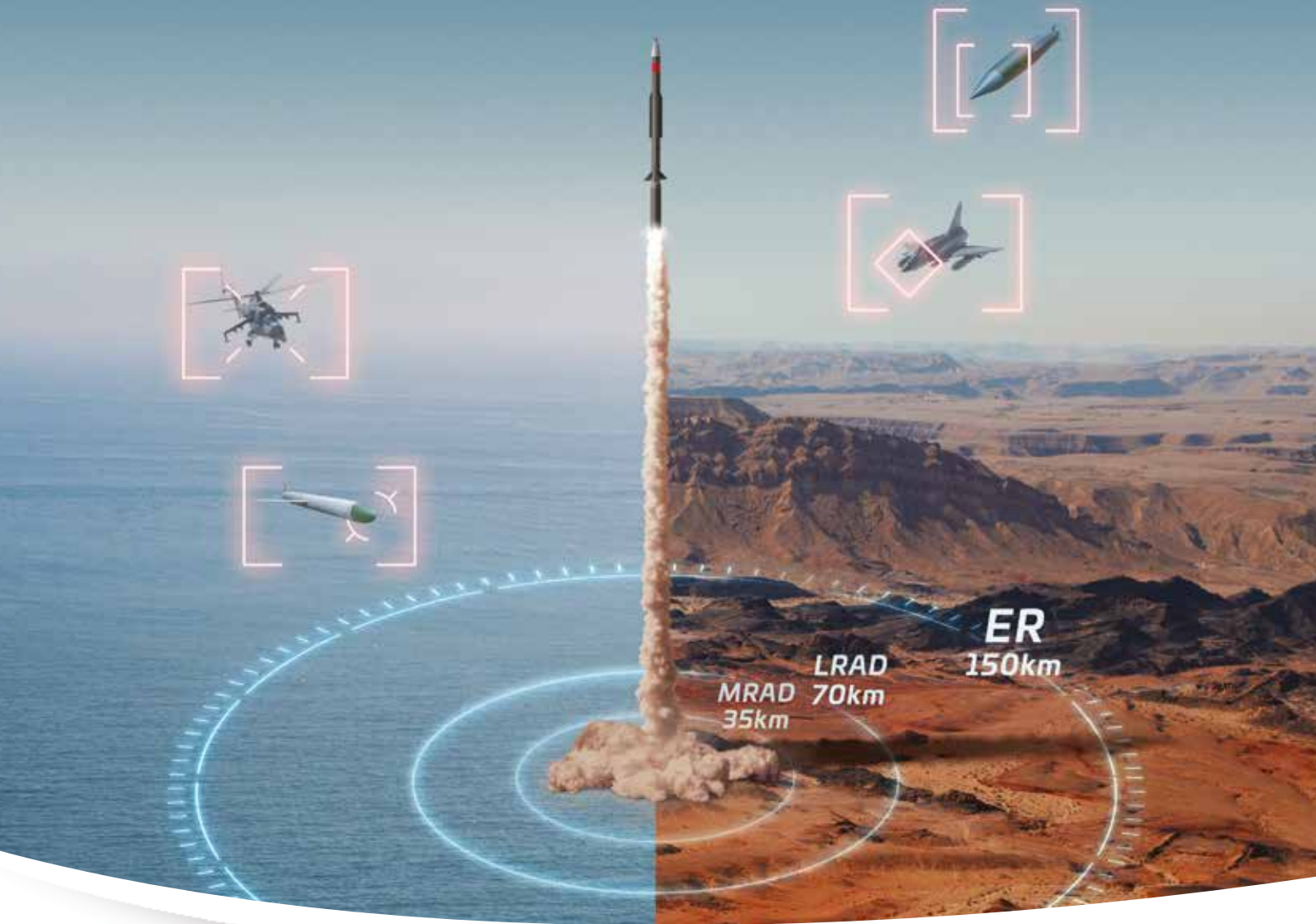
D S E I

## DSEI 2021 Focus

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- Poland's Defence Export Ability
- CH-47 Modernisation in Europe
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## Back to the Beginning



ESD is approaching the end of Phase One of its re-launch – the first 7-year plan - so it seems appropriate to review some of the key developments since January 2015.

EUROPEAN SECURITY & DEFENCE was established back in 2002, as a quarterly translation of “the best bits” of her German-language sister magazines. Distribution was some 3,000 copies per issue, through and to the Defence Attaché network, primarily in Europe. So, 12,000 copies per year.

On re-launch in January 2015 we increased the frequency to bimonthly, and launched the ESD Spotlight newsletter, later joined by the naval journal, MARITIME SECURITY & DEFENCE. Subsequently the ESD publishing schedule was increased to eight issues per year and then 11, with a combined November-December edition allowing us to regroup, reassess, adjust and begin each year with fresh impetus. This slight hiatus also permits us to consider our own organisations, hierarchies and processes, with a view to building a simple, clear and consistent supporting structure that mirrors the magazine itself.

Our audience has also increased significantly, particularly for the digital editions, which are freely available at [www.euro-sd.com](http://www.euro-sd.com), and will remain so until February 14th 2022. Both the website and our social media groups continue to grow, while their focus remains upon the expert, decision-making reader.

We have also increased our partnerships and presence at all the major and most of the smaller defence exhibitions, conferences and seminars - especially within Europe, but also worldwide. Attendance and bonus distribution of the relevant editions of ESD has ranged from Tokyo to Bogotá and from Stockholm to Pretoria, in support of our mission of opening doors within Europe and promoting European capabilities, companies and products in the defence and security domains. Covid notwithstanding, we look forward to meeting our readers and partners at almost 60 events in 2022.

Covid has of course affected ESD, presenting significant challenges in terms of magazine distribution and face-to-face meetings. Some of these have been mitigated by the significant upswing in digital readership, and some by conference call tools, but the growing threat of cyber-attacks and the difficulties of reaching through some very comprehensive firewalls – plus the diffuse reach of electronic media – remain an obstacle to simple but sustained communication. And sustained, targeted communication over extended periods of time is where print continues to be the default medium of choice – especially when the target audience is properly defined and identified.

Nevertheless, ESD has continued to grow and mature, even in the face of the sudden, tragic loss of Dr Peter Boßdorf early last year; much of the impact of the publication was due to his efforts.

I'd like to take this opportunity to thank, most sincerely, our readers and writers and our partners from the professional, expert worlds of politics, the military, industry and the media. Specialist media like ESD exists to be the oil in the machine that is the global defence industrial complex, and the reward of working here is the cherry on the icing of a cake that continues to be made. We have a long and interesting road ahead, and our course is steady, so for the moment: - Thank you all!

P.S. In closing, for this specific edition I'd like to acknowledge a particular debt to John Clarke and Bryan Dawe.



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## ■ Improved Protection for Turkish LEOPARD 2 A4s

(gwh) Turkey is modernising some of its 354 LEOPARD 2 A4 main battle tanks, which it acquired from Bundeswehr stocks between 2008 and 2013. The tanks, designated LEOPARD 2 A4 T1s, will receive improvements in command and fire control equipment as well as increased protection against threats in current combat environments.

After the first modernised main battle tanks were publicly unveiled in February 2021, the Head of Turkey's Defence Industries Bureau (SSB), Ismail Demir, has now announced via Twitter that mass production of the kits for the increased armour protection has begun at Aselsan. The new protection package has been developed at the Roketsan Ballistic Protection Centre, which has just come into operation. Building on the existing ballistic protection of the LEOPARD 2 A4, protec-

Photo: Oshkosh Defense



tegrated product support. With this, up to six STRYKER Brigade Combat Teams (SBCT) are to be equipped with 83 converted vehicles each. The first call-off now made, worth around €107M, is for 91 vehicles to be delivered by December 2023 with the entire programme to be completed by 2027.

Oshkosh is working with vehicle developer Pratt Miller – which was acquired by Oshkosh during the bidding phase – and Rafael to execute the contract. For the demonstrator, the SAMSON turret incorporated a Northrop Grumman XM813 gun, an evolution of the BUSHMASTER automatic cannon for use with programmable munitions. The medium-calibre weapon system is considered highly accurate and effective.

The new order to integrate a 30 mm turret into the STRYKER follows the positive experience with the STRYKER DRAGOON, which has been used with the same weapon – albeit in a Kongsberg turret – by the SBCTs stationed in Germany since 2017. It is known from the DRAGOON that the approximately two-tonne turret resulted in reinforced wheel suspensions and wider tyres in addition to interventions in the roof of the STRYKER.

## ■ New PMPV Variants

(gwh) Finnish vehicle manufacturer Protolab has announced the introduction of two new versions of the 6x6 Protected Multi-Purpose Vehicle (PMPV), which have been modified based on user feedback to meet the requirements of the Finnish procurement programme.

While retaining the proven mine protection, the PMPV has been given a more powerful engine. There is a choice of engines with 240 kW, 270 kW or 335 kW drive power, which is distributed to the three axles via an Allison gearbox. Front

Photo: Protolab



and rear axles are steerable. With a curb weight of 14 tonnes, the maximum payload capacity is for 10 tonnes.

The redesigned interior with more space for C4I equipment includes seating for a crew of two and a group of ten infantrymen. Optionally, different seating systems with two or five point harnesses are available. Crew entry and exit have also been improved and the hatch closure system in all vehicles has been redesigned for easier operation. Comfort improvements are to increase the crew's staying power while the vehicle is comparatively narrow at 2.55 m.

Based on the standard configuration, variants for command and control, troop transport or medical operations can be deployed. In mid-2019, Protolab had delivered prototypes of the PMPV for testing to the Finnish Armed Forces.

## ■ Russian President Meets Top Brass

(yl) Russian President Vladimir Putin recently held several meetings with high ranking military officials and industrialists to determine: "organisational and economic solutions on strengthening the Army, the Navy and the military-industrial complex" of Russia. The national media disclosed several details of these "working meetings".



Photo: Iskander tactical missile system, courtesy HPW Holding

The Supreme Commander stated that recent military conflicts have shown the decisive role of various cruise missiles and guided munitions. He stated that the Russian Armed forces have been receiving Kh-101, CALIBER and ISKANDER cruise and ballistic operational-tactical missiles, multiple launch rocket systems, as well as various guided aerial bombs.

The Russian leader mentioned that this weaponry is equal to or surpasses all foreign counterparts with some not having a rival in the world. The weapons were combat tested in Syria to prove their characteristics.

The national leaders in the field of smart weaponry are Tactical Missile Corporation and High Precision Weapons Holding.

Photo: SSB



tion is increased with add-on modules for turret and hull, with complementary roof protection, heavy track skirts and cage armour. With liners in the hull and turret as well as mine-resistant seats and equipment arrangement, the crew is better protected against the effects of ordnance. A halon-free fire suppression and extinguishing system also contributes to this.

Because of the German Government having imposed restrictions on the export of defence materiel to Turkey after the delivery of the MBTs, Turkey has been looking for a way to increase the number of tanks. As a result, the ALTAY main battle tank was developed, the introduction of which is still awaited.

## ■ 30mm Gun Turret for STRYKER

(gwh) The US Army is equipping some of its 8x8 STRYKER combat vehicles with unmanned 30-mm gun turrets. In a framework contract with Oshkosh Defense (who announced the news) as prime contractor, the US Army Contracting Command has agreed to integrate remotely operated 30-mm SAMSON gun turrets on STRYKER chassis double v-hull infantry carrier vehicle for around €777.6M. The contract also provides for technical system support, logistic support by an intermediate supplier and in-



President Putin also paid special attention to military transport aviation developments. He noted that well-coordinated work and high readiness of the aircraft fleet largely determines the mobility of troops and the possibility of their rapid deployment over long distances.

He said that a number of the Antonov An-124 super-heavy transport aircraft have been maintained by using "domestic components". In other words, the Ruslan serviceability has been maintained with no involvement from Ukrainian companies.

President Putin also mentioned that state tests of the IL-112V light transport aircraft are almost complete with two vehicles to be handled to the Russian Aerospace Forces (VKS) this year. He stated the production of IL-76 was resumed on a new technological basis. By the end of the year, five newly produced IL-76MD-90A aircraft are to enter service with the VKS.

#### ■ MWTSS Passes Acceptance Testing

(jr) InVeris Training Solutions has announced that it has successfully passed on-site acceptance testing for 14 Mobile Weapon Training Simulation Systems (MWTSS) and an additional 73 EF88 weapon simulators for the Australian Defence Force (ADF). The MWTSS has the same capability as the fixed WTSS but in a single (4.2m x 2.4m) screen mobile configuration that will be deployed to remote locations around Australia, overseas and on Royal Australian Navy (RAN) fleet units. An additional four MWTSS units have been ordered and the currently fielded trial system will be refurbished to the current build standard then returned for use, providing an initial tranche of 19 systems.

The MWTSS will be provided in multiple configurations designed to cater for the needs of those units and regions receiving the capability. Every system will have purpose-designed Trimcast™ cases for air compressor, air cylinders, binoculars and ancillaries. Operational units and the RAN will receive the EF88 weapon simulator, also in Trimcast cases, with other systems delivered with F88 weapon simulators in the interim. Units deploying overseas or on fleet units will have a complete spare parts kit to cater for any maintenance issues whilst deployed. The MWTSS replaces the Portable WTSS which commenced trials in 2006 and entered service as an interim solution in 2014. MWTSS will be supported under the WTSS service support contract by InVeris, with instructor courses being conducted from June 2021, commencing at HMAS PENGUIN.

#### ■ Babcock CEO Hosts ARROWHEAD 140 Meetings in Greece

(jr) Babcock International CEO David Lockwood has led a series of meetings in Greece with key industry figures, government officials and supply chain companies as Babcock continues to build international interest in its ARROWHEAD 140 general purpose frigate bid to deliver the Hellenic Navy's new frigate modernisation programme.

A comprehensive programme of discussions was undertaken as Babcock reinforced the strengths of the offer made by the company and the UK Government to provide the Hellenic Navy with a HYDRA class upgrade programme, an interim frigate capability and four Babcock ARROWHEAD 140 frigates. The ARROWHEAD 140 has already been chosen by the Royal Navy for its Type 31 programme.



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Image: Babcock

The company is committed to supporting Greek industry to build and assemble the new frigates in Greece, reinvigorating the domestic supply chain, upgrading infrastructure, modernising domestic facilities, upskilling and growing local workforces and transferring knowledge and technology.

Babcock officials have also been engaging with Greece-based companies interested in being part of its in-country supply chain and recently held a live online event in Athens, under the auspices of the Hellenic MoD Armaments Directorate.

This follows on from previous discussions held in Greece between British Government officials, Babcock and the Hellenic Navy, which included visits to both Greek shipyards. The ARROWHEAD 140 design features a proven hull-form that has been tested in

operational environments from NATO and coalition task forces, to national, regional and deployed operations. Babcock's offering provides a design with the scope to adapt to specific operational and layout requirements.

This is a modular build, which Babcock, as part of the Aircraft Carrier Alliance, has proven effective through the construction of the UK Royal Navy's Aircraft Carriers – assembled at its facility in Rosyth, Scotland, which is also the site for construction of the UK's Type 31 frigates.

### ■ Luxembourg Procures 80 Multi-Purpose Tactical Vehicles

(gwh) Luxembourg's Defence Minister François Bausch has presented the plan for the procurement of 80 protected armoured Command, Liaison, Reconnaissance Vehicles (CLRV). Earlier, the governing council had approved the planned expenditure of €367M, which still has to be approved by parliament. The new vehicles are to replace the protected HUMMER and DINGO 2 vehicles in 2024/2025. The 42 HUMMERs have been in service since 1996. The platform, radio and weapon are outdated, protection is inadequate. The 48 DINGO 2s have been in service since 2010. The radio and weapon system are

obsolete. The aim of the procurement project is uniform equipment at company level and closer alignment with the privileged partner Belgium in order to achieve advantages in deployment, training and logistics with interoperable and compatible equipment for the next 15 to 20 years. Belgium equips its forces



Photo: Mod Luxembourg

with French SCORPION vehicles. Luxembourg wants to follow suit. The only vehicle of the SCORPION family to be considered for the Luxembourgian requirement is the GRIFFON multipurpose vehicle, although it weighs more than twice as much as the vehicles to be replaced. For the procurement, Luxembourg has called in the NATO Support and Procurement Agency NSPA. Within the given ceiling of €367M, about one-sixth (€61M) is earmarked for the procurement of the platforms, one-third (€122M for electronic equipment including radios, jammers, sensors and armament, and about 50% (€184M) for logistic support in operation.

### New PBS TJ80M-Propulsion Unit for UAVs

Czech aerospace company PBS is introducing the new PBS TJ80M turbojet engine modification, which offers an increased thrust of 1,280 N while retaining the same weight and outer diameter with reduced fuel consumption.

In the middle of 2018, PBS Velka Bites (PBS) introduced the PBS TJ80 jet engine, which provides a 900 N thrust in a relatively small body.

The continuous development of PBS turbojet engines resulted in a significantly upgraded PBS TJ80M that will be unveiled in the second half of 2021. PBS TJ80M features a modernised compressor stage, a modified axial turbine, and a new fuel system. The result of these modifications is an increase in engine thrust by 42 %, from 900 N to 1280 N, while reducing the specific fuel consumption. The PBS TJ80M turbojet engine has an electrical output of 2.3 kW/28 V, 12 kg weight, and only 235 mm diameter.

In the scope of this project, a new spark plug of only 18 mm height is being developed which, due to smaller installation dimensions, facilitates integration with the engine. New control algorithms

have been implemented to full exploit the engine's thrust potential.

As a 100 % "ITAR-free" propulsion unit, PBS TJ80M, is offered for a wide range of unmanned aerial applications.

The "M" version constitutes the first stage of the modernisation programme. PBS will direct its development activities

to further increase thrust and introduce a saltwater version for landings in saltwater and continued use thereafter.

PBS offers additional services, such as optimisation of the air inlet channel, UAV fuel system, or integration of PBS engine control with the UAV control system.



Photo: PBS

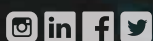
**The turbojet engine PBS TJ80M**

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## ■ BAYRAKTAR UAV for Poland

(Korhan Özkilinc) The Polish Minister of Defence, Mariusz Blaszczak, and the CEO of Baykar, Haluk Bayraktar, have signed a contract for the purchase of 24 BAYRAKTAR TB2 UAVs (four squadrons, each consisting of 6 TB-2s), in the presence of Turkish Presi-



Photo: euro-sd.com

dent Recep Tayyip Erdogan and his Polish counterpart Andrzej Duda. Under the terms of the contract, the UAVs will be equipped with Roketsan MAM-L and MAM-C anti-tank missiles while some will have an SAR radar. This is in addition to the training simulators while Poland will also get an unknown number of mobile stationary mission control stations. The first UAVs will be delivered in 2022 and the last at the end of 2024.

## ■ 2021 Entrepreneurship Award for Christina Polster/ PIK-AS Austria GmbH

The Austrian female entrepreneurship award, issued by the Austrian Chamber of Commerce, in cooperation with "Die Presse", took place for the 7th time this



Photo: PIK-AS

year. 165 women entrepreneurs submitted this time for the coveted award. The prize in the export category goes to PIK-AS Austria GmbH in Mariasdorf. The company PIK-AS Austria GmbH was founded in 1982 by Franz Polster and was taken over by his daughter, Christina Polster, in 2015. The company produces and sells electromechanical components such as high power relays, power connectors, special switching systems and LED interior lighting for military land vehicles.

## ■ Hanwha Targets UK MFP Requirement

(jr) Hanwha Defense has announced that it has begun formal discussions with UK partners to arrange for a 'Made in the UK'

variant of its K9 Self-Propelled Howitzer. The K9 is operationally proven and will be put forward by Hanwha Defense for the UK's Mobile Fires Platform (MFP) programme to equip the British Army with a new artillery capability.

The K9 is currently in service with the ROK and armies around the world, including India, Norway, Finland and Estonia. In September 2020, the Australian Army selected the K9 as its preferred solution for the Protected Mobile Fires platform in its LAND 8116 programme, with a final contract due to be awarded in early 2022. Hanwha Defense intends to replicate the successful industry participation model



Photo: Hanwha

used in India and Australia. The company is also committed to transferring related technology and know-how to the UK, enabling its UK partners to access a global market which is believed to be in excess of 600 vehicles.

Talks are already underway with Lockheed Martin UK, Pearson Engineering, Horstman Defence Systems and Soucy Defense, along with other UK defence industry partners. As part of the MFP programme, Hanwha Defense will contribute across the UK to introduce specialist training and new skills for the long-term development, manufacture, maintenance and support of the British Army's advanced version of K9.

Tests and evaluations for the newest version of K9, dubbed the K9A2, are already in full swing to increase the artillery's key capabilities, including the maximum rate of fire and automatic ammunition loading functions. The K9A2 development has been led by Hanwha Defense and the Korean state-funded Agency for Defense.

## ■ RUAG Receives SAR for Engine Contractss

(jr) RUAG has received Source Approval Request (SAR) approval for maintenance and repair work on J85-GE21 engines for the US Government. Only suppliers with SAR approval are taken into consideration for tenders and contracts with the US DoD. With SAR approval for complete engines in the field of F-5 services, RUAG will continue to secure its



Photo: RUAG

strategic partnership with its customers in the long term and provide high-quality services. This will be valid for several years. RUAG secures its know-how and expertise thanks to its international assignments, thereby creating synergies for its clients in Switzerland.

## ■ First Australian BOXERs Delivered

(gwh) The Australian Defence Force has taken delivery of the first tranche of 25 BOXER CRV 8x8 wheeled armoured reconnaissance vehicles. In 2018, the Australian Government signed a supply contract with Rheinmetall Australia for 211 BOXERs in seven versions for €2.7Bn under the Land 400 Phase 2 armament project. It is agreed that the BOXERs will be delivered in two tranches: Tranche I (Block I) with 25 vehicles until the end of 2020 and Tranche II (Block II) in the period 2022 to 2027. Tranche I has now been delivered, comprising 13 multi-purpose and 12 reconnaissance vehicles, the latter with turret and 30 mm gun. This will enable the Australian Army to reach the first stage of operational capability as planned. The vehicles were handed over at the purpose-built Military Vehicle Centre of Excellence (MILVEHCOE) in the presence of Australian Defence Minister Peter Dut-



Photo: Rheinmetall

ton. Phase 2 of the project is now beginning for Rheinmetall. Currently, 30 Australian employees from Rheinmetall Australia are working at Rheinmetall sites in Germany and learning about production. The 2018 contract also provides for know-how and technology transfer, so with the start of Tranche II, production will be gradually transferred to Australia. The plan is that from vehicle No. 31 (in May 2023) onwards, production will take place entirely in Australia.



In Tranche II, 121 reconnaissance and 15 command and control vehicles are planned, alongside 29 vehicles for joint fire surveillance, 11 recovery vehicles with a winch system and 10 repair vehicles with a crane.

Knowledge transfer for full BOXER production in Australia is expected to begin once commissioning of the BOXER production line at the MILVEHCOE is complete.

### ■ Patria 6x6 Tours Latvia

(jr) Patria has announced that the joint Finnish/Latvian 6x6 vehicle development programme is proceeding as planned, with a successful Demo Tour in Latvia and increased interest in the programme. The demo tour was held in Latvia during May, where the Patria 6x6 vehicle was presented to the Minister of Defence and the Latvian armed forces, who tested the mobility features and capability of the vehicle under conditions that correspond to the vehicle's operational environment.

More than a hundred people from the Latvian military got a chance to test the vehicle, as well as its loading capacity for special purposes. Representatives of the Finnish Ministry of Defence and the Finnish Defence Forces



Photo: Patria

also attended the event. The demo tour culminated in the Industry Day with the Latvian defence industrial base, which has an essential role in the vehicle programme. Security of supply, including local industry participation, is part of Patria's business model to enable a cost-effective supply chain.

Currently, the programme is in the Research and Development (R&D) phase, which means engineering and development work, so that the basic vehicle platform, versions and the total system, including the support system, are developed further according to the specific needs of participating countries.

### ■ Sensor Upgrade for German F124 Frigates

(jh) The German Federal Office of Bundeswehr Equipment, Information Technology and In-Service Use (BAAINBw) has signed a contract with Hensoldt Sensors for the delivery and installation of four radar systems for the SACHSEN-class frigates (F124) with a contract value of around

€220 million. Training and logistic support are also part of the agreement.

The new radars are long-range radars for air and sea surveillance of the type TRS-4D/LR ROT for air and sea surveillance, which will replace the SMART-L radars currently in use on the three frigates.



Image: BAAINBw

A fourth system will be installed at the test reference and training facility at the Naval Technology School in Parow. In addition to the training, there is also the possibility of testing possible system modifications on the radar before they are implemented.

The three F124 units were put into service between 2004 and 2005. They are designed as multi-purpose frigates for convoy protection and sea control. All sensors and weapons on board are optimised for air defence. The frigates of the class F124 frigates are also the only ships in the German Navy with the ability to provide anti-aircraft defence.

With the TRS-4D/LR ROT, the ships will have the ability to detect and track ballistic missiles. The radar's AESA technology (AESA = Active Electronically Scanning Array) enables the precise detection of particularly small and manoeuvrable objects at a range of more than 400 km for air targets and up to 2,000 km for objects in Earth orbit. The conversion of the ships will begin in 2024 and should be completed by 2028.

### ■ Dutch Multi-Mission Radars for Norway

(gwh) The Norwegian Armed Forces will receive five GROUND MASTER 200 Multi Mission Compact (GM200 MM/C) radars for immediate fire support and air defence, the Dutch MoD has announced. With support of the Dutch Government, the Royal Netherlands Army initiated the procurement of the radar systems on 25 May 2021, with an option for three more. The systems, manufactured by Thales Netherlands, will be delivered from late 2023 to late 2024. The Netherlands had already ordered nine GM200 MMs for its own armed forces in 2019, to be delivered from the end of 2022.



Photo: Defensie



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Photo: euro-sd.com



## ■ New GALILEO Satellites Ordered

(gwh) The European Satellite Navigation System is being expanded with 12 new satellites after the European Space Agency (ESA) announced that it has awarded Thales Alenia Space (Italy) and Airbus Defence & Space (Germany) two similar contracts worth a total of €1.5Bn to build two independent satellite families with a total of 12 second-generation GALILEO satellites. The contracts could only be signed recently, after an appeal against the award was rejected by the courts.

Image: ESA



GALILEO is Europe's civilian global satellite navigation constellation, currently the most precise satellite navigation system in the world, providing metre-scale accuracy to more than two billion users around the globe. With improved accuracy, the new generation should be able to provide decimetre-scale precision positioning to all users. These second-generation GALILEO satellites (G2) are expected to revolutionise the fleet. They complement the 26 first-generation GALILEO satellites in orbit today and the 12 "Batch 3" satellites currently in production and testing. The first launch of these Batch 3 satellites will take place later this year. The new G2 satellites are being built to a short timescale, with their first launch expected in less than four years.

## ■ MQ-9 Fleet Upgrade for Italy

(jr) The Italian Air Force has partnered with the US Government and General Atomics Aeronautical Systems, Inc (GA-ASI) to provide a mid-life update for its fleet of MQ-9 remotely piloted aircraft and ground control stations as part of a Foreign Military

Sales agreement. Announcing the news, GA-ASI said that the Italian Air Force's mid-life modernisation programme will include updates to the MQ-9s which will improve them from Block 1 to Block 5 configuration. The latter includes a significantly increased electrical power capability, improved landing gear and the latest versions of the GA-ASI LYNX multi-mode radar and electro-optical sensors from Raytheon.

## ■ RCH 155 Wheeled Howitzer – KMW Demonstrates Firing on the Move

(lh) During a presentation at the Kletitz military training area in Germany, Krauss-Maffei Wegmann (KMW) demonstrated the live firing of the wheeled Remote-Controlled Howitzer 155mm (RCH 155) in motion for the first time in front of an audience. The Remote Controlled Howitzer 155mm (RCH 155) was used. The weapon system combines the Artillery Gun Module (AGM) from KMW - a fully automatic gun turret - with the chassis of the BOXER wheeled armoured vehicle.

Artillery firing on the move is likely to have been a world premiere. The Finnish company Patria has already demonstrated firing on the move with its NEMO mortar. However, such a capability has not been recorded for a 155mm howitzer, as Bundeswehr artillery experts confirmed at the event.

Besides, the RCH 155 demonstrated the Multiple Rounds Simultaneous Impact

(MRSI) mode. In this application variant, several projectiles are fired from a single howitzer at a rapid firing rate, all hitting the target at the same time. This is made possible by calculating the barrel elevations and propellant charges of the individual shots in such a way that a simultaneous impact on the target is achieved through different flight times.

KMW has also modified the wheeled howitzer with the so-called hunter-killer capability to engage an enemy in direct fire. For this purpose, the optronics of the remotely operated weapon station (FLW 200) integrated with the system are used in combination with e.g. an MG 5 machine gun, as presented during the demonstration. With this method, the commander acquires the target with the optics of the weapon station, upon which the 155mm main weapon is automatically tracked and can be triggered. This principle was also demonstrated in live firing mode.

Although the RCH 155 is a wheeled system, unlike other howitzers on truck chassis, no props are extended. This significantly increases the speed of operations. In terms of personnel, only one driver and one commander are needed.

The guests at the event included numerous officers from the German armed forces, the British Army and procurement authorities as well as a small delegation from Qatar. According to Bundeswehr circles, there is interest in introducing new wheeled howitzers in the second half of this decade to complement the PANZER-HAUBITZE 2000. The British Army also intends to invite bids to replace its ageing AS 90 systems.

## ■ TORNADO Modernisation for Bundeswehr

(gwh) Now that the German Parliament cleared the way for a comprehensive obsolescence and vulnerability elimination of the combat aircraft's self-protection equipment, the Bundeswehr's TORNADO multi-role combat aircraft fleet will receive a state-of-the-art radar warning suite by 2025. To this end, the NATO Eurofighter and Tornado Management Agency (NETMA) has concluded a corresponding contract worth €102.3M with the prime contractor Panavia Aircraft, which provides for the adaptation development and integration of components in the period 2021 to 2025.

Under a subcontract, Saab will deliver modernised radar warning equipment for around €40M, which will provide future-proof processor performance and extend

Photo: Lars Hoffmann



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Photo: Bundeswehr



the service life of the TORNADO's radar warning system. According to Saab, the warning equipment provides aircrews with superior situational awareness in the electromagnetic spectrum, even in challenging scenarios. Saab was first awarded a contract to renew radar warning equipment for German TORNADOs in 1999.

### ■ MBDA SEA CEPTOR for Type 31

(jr) Under a contract awarded by the UK MoD, MBDA's SEA CEPTOR system will protect the Royal Navy's new Type 31 frigates. The system will allow the Type 31 to simultaneously protect both itself and vessels near it from attack by air- and sea-based threats, including high-speed manoeuvring missiles,

Image: MBDA



hostile aircraft and fast inshore attack craft. The new contract includes integration of SEA CEPTOR with the Type 31's systems, along with delivery and installation of ship hardware for the Type 31 programme. Designed and made in the UK, the contract forms part of the Portfolio Management Agreement (PMA), a partnership initiated in 2010 between the UK MoD and MBDA on sovereign complex weapons design and production. The PMA delivers military equipment for the UK Armed Forces and has secured over 4,000 jobs at MBDA UK while generating savings worth over £1.2Bn.

SEA CEPTOR is currently in service on the Royal Navy's Type 23 frigates, and will also protect the new Type 26 frigates. The UK MoD maintains a common stockpile of CAMM missiles for both the Royal Navy and British Army, with the system having been selected by a growing list of other nations for both naval and land-based air defence.

### ■ Russian Industry Update at HeliRussia

(yl) The HeliRussia exhibition was held from 20 to 22 May in Moscow, making the show one of the very few international events held against the background of the current pandemic. Apart from being a meeting point for the rotorcraft industry, HeliRussia-2021 gave a real chance to receive a fresh portion of information on Russian defence exports. On the first day of the show, Rosoboronexport CEO Alexander Mikheev (pictured) disclosed several figures. According to him, over the last 10 years alone, Rosoboronexport has offered and successfully delivered over 850 helicopters worth about \$20Bn to more than 35 countries. He also mentioned the total volume of the Rosoboronexport current portfolio is \$52.1Bn.

The national state exporter has already supplied to customers about 23 per cent of the total volume of weapons scheduled in this year's plan. Mikheev stated that in 2020 Rosoboronexport sold military products worth about \$13Bn and has already signed contracts for \$4Bn in 2021.

The company booth at HeliRussia 2021 presented the most popular export models of the Russian-made military and dual-purpose helicopters, one being the Mi-17V5 military-transport rotorcraft. According to Mr. Mikheev, more than 270 of this type have been delivered over the last decade.

Other items presented by Rosoboronexport included:

- An upgraded version of the Ka-52 attack helicopter,
- Mi-28NE new generation attack helicopter with round-the-clock capabilities,
- Mi-35M and Mi-35P gunships,
- Mi-171SH special forces support helicopter,
- The new Mi-38T medium assault/transport helicopter.

Mr. Mikheev also stated that "the first deliveries of S-400 TRIUMPH anti-aircraft missile systems to India will take place in October-December this year". He added that Indian personnel training is on schedule.

Photo: Yuri Laskin



According to Mr. Mikheev, Rosoboronexport promotes Russian military drones for export only after they are adopted by the Russian Army. He also mentioned that Russia's anti-terrorist operation in Syria helps promote the country's defence equipment to the world market.

### ■ US Army to Test SRT

(jr) AM General recently received a Firm-Fixed-Price (FFP) contract from the US Army to provide two HUMVEE 2-CT HAWKEYE Mobile Howitzer Systems (MHS) for the service's characterisation test, the company said in a press release.

AM General and its strategic partner, Mandus Group, have been integrating the Soft Recoil Technology (SRT) onto light, mobile, transportable and survivable platforms without sacrificing firepower. According to AM General, SRT is a disruptive technology that will reduce the firing loads for direct and indirect weapons systems, enabling combat systems to meet emerging requirements. The technology is ready now and can be deployed on existing weapon platforms for an immediate effect on the battlefield. Soft recoil enables reduction in overall system weight, making systems more agile and responsive to benefit the supported manoeuvre commander.

Photo: AM General



The HUMVEE 2-CT (M1152 two-door cargo truck) that serves as the mobile platform, will come with a standard 14,100 lb. gross vehicle weight, 205 hp engine and antilock braking system (ABS). While the US Army conducts characterisation testing of the 2-CT HAWKEYE MHS over the next year, AM General and Mandus Group will continue to refine the technology for integration of the soft recoil technology onto other mobile platforms. Scaleability is already being tested with a 155mm prototype. The group is also exploring integration onto other existing and future combat systems.

### ■ LM-LowProfile Laser Modules for Portugal

(jr) The Portuguese Army has awarded Rheinmetall an order for 1,500 LM-Low-Profile laser modules. The contract, booked

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Photo: Rheinmetall

back in October 2020, calls for delivery of the devices in three lots with delivery to be completed by the third quarter of 2021. The order is worth a figure in the low single-digit million-euro range. In carrying out the order, Rheinmetall is cooperating closely with its local sales partner, NT Group Portugal.

Developed by Rheinmetall Soldier Electronics of Stockach, Germany, the minute LM-LowProfile laser module is designed for use on compact assault rifles, but is also suitable for other small arms. The device, weighing around 160 grams and being 85 mm long, can be attached to any standard assault rifle via a standard interface as defined by MIL-STD 1913/NATO STANAG 4694. Owing to its low height (25 mm), it can be used in combination with daylight optics, nor does it interfere with the line of sight. Adding a tactical weapon light further enhances the laser module's operational effectiveness. Rheinmetall has already supplied the Portuguese Army with a weapon light in an earlier order. Delivery is already underway. This is the third order from Portugal in three years.

### ■ HENSOLDT to Develop Collision Warning System for Drones

(jr) HENSOLDT is vigorously pushing ahead with the development of a collision warning system for civil and military drones. This comes after the radar sensor as the core element of a collision warning system was successfully tested in flight as part of the ProSA-n (military) and KoKo2 (civil) study programmes. Work on the software required for interaction with an autopilot is well advanced. As early as this summer, a demonstrator of the collision warning system is to prove in flight tests that the sensor performance and the software-supported avoidance logic correspond correctly with the autopilot.



Photo: HENSOLDT

Since the beginning of the year, HENSOLDT has also been involved in the European Detect and Avoid System (EUDAAS) programme, in which several European companies are developing a concept for bringing large military Medium Altitude/Long Endurance (MALE) drones, such as the EURO-DRONE, into European airspace.

HENSOLDT's "detect-and-avoid" radar uses the latest Active Electronically Scanning Array (AESA) technology, which allows multiple detection tasks to be performed simultaneously and enables very rapid target detection. The scaleable radar can be used in large military drones as well as on board smaller civilian drones.

### ■ 100<sup>th</sup> A400M delivered

(wge) On 24 May 2021, Airbus delivered the 100th A400M airlifter. The customer, the Spanish Air Force, received its tenth of 27 aircraft with the transfer flight of the aircraft with serial number MSN111 from Seville to Zaragoza, the location of the Spanish A400M fleet. The newly delivered A400Ms are equipped for all previously certified capabilities. In total, 174 aircraft have been ordered by international customers. The fleet, which has already been delivered, reached 100,000 flight hours during the same week in worldwide operations.

Photo: Airbus



A few weeks before, the latest generation A400M successfully completed flight tests for helicopter refuelling in a major certification campaign. Furthermore, the capability to drop up to 116 paratroopers with automatic parachute release from the side doors and to drop free-fallers from the ramp has already been demonstrated. In cooperation with British paratroopers and the Royal Air Force, tests took place in Spain with automatic jumps at 7,600 m and freefall jumps from 11,582 m.

Further tests to increase airdrop capacity and certifications for airdrop have also been carried out. These include dropping multiple platforms with parachutes up to 23 tonnes and dropping loads on pallets on difficult paved and unpaved runways by dropping loads of up to 19 tonnes (in one pass) or 25 tonnes (in two passes).

A new capability for military transport aircraft was demonstrated with the certification flights for automatic low-level flight

capability under Instrumental Meteorological Conditions (IMC). This capability was achieved through the use of navigation systems and terrain databases without the use of a terrain-following radar system.

France used an A400M to deliver food, water, fuel and ammunition to its troops in the Sahel, the first time it had dropped supplies in a country outside Europe. Germany successfully used the A400M to carry out aerial refuelling in Operation COUNTER DAESH in Jordan.

### ■ New Generation ACRO Red Dot Sight Introduced

(gwh) The pioneer for red dot sights, Aimpoint from Sweden, has further developed the electronic ACRO reflex sight. The sight enables aiming with both eyes even in difficult environmental conditions (humidity, snow, dust). The 47 x 33 x 31 mm ACRO sight weighs 60 g and is mounted on the gun. For the new generation, the LED emitter that produces the red aiming dot has been improved and is powered by a reinforced CR2032 battery for up to 50,000 hours (more than five years) at setting 6. The LED, which can be dimmed to match the ambient light, provides a sharp 3.5 MoA (Minutes of Angle) dot. This means that the dot covers an area of approx. ten centimetres in diameter on a target at a distance of 100 metres. The inner reflective lens system is protected by protective lenses on the front and back. The intensity is adjusted in ten steps by two buttons on the left side of the housing. If necessary, the view in and out can be covered with protective flip-up lens covers.

The ACRO sight with fully enclosed optical channel was developed for use on pistols, but can also be used with standard interfaces (e.g. PICATINNY rail) on rifles and long guns. The design parameters refer to firing

Photo: Aimpoint



tests on a semi-automatic pistol. The ACRO sights proved that they can withstand the shocks, vibrations, temperatures and material stresses that occur when firing over 20,000 rounds of Smith & Wesson cal 40 (.40 S&W) ammunition.

The ACRO-P2 professional version is intended for use by military and security forces and offers greater resistance to external influences as well as six adjustment options for day use and four for interaction with night vision devices.



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It's my great privilege to welcome you to DSEI 2021, you have chosen a particularly auspicious time to visit our world renowned Defence and Security exhibition.

Since the publication of both our Integrated Review of Security, Defence, Development and Foreign Policy and our Defence Command Paper earlier this year, the UK's Armed Forces have embarked on their biggest transformation since the end of the Cold War. Over the next four years, we're going to be spending £188Bn on Defence - an increase of £24Bn - on a force fit for the future.

In a series of eye-catching zones, you'll get a glimpse of what that modernisation means across every domain.

In the land zone you'll find out how we're upgrading our capability to deliver competitive advantage, whether bringing in a new fleet of 148 Challenger 3 Main Battle Tanks, or state-of-the-art Boxer armoured fighting vehicles.

In the aerospace zone, you'll discover how we're taking integration between Government, industry and academia to the next level. Our new Defence and Security Industrial Strategy gives us a

## Welcome to DSEI

powerful framework for working more closely with top-flight research and with those companies, great and small, that make the UK - and companies that locate here - so celebrated for their pioneering spirit. Our Future Combat Air System (FCAS) is putting those principles into practice. This is not just a sixth-generation system with a virtual brain, embracing artificial intelligence, deep learning, novel sensors and communications technologies. It is a partnership where £2Bn of Government investment is leveraging hundreds of millions from industry, training 2,000 apprentices and galvanising an entire sector.

In the maritime zone you'll see how we're backing innovation. Artificial Intelligence and autonomy will protect our maritime assets while our experimentation with underwater drone swarms and, above the water, Directed Energy Weapons, could one day give them the cutting edge they need. In the coming years, UK Defence is committing a minimum of £6.6Bn across the board to R&D, allowing us bring forward critical next-generation technology.

Switch from naval to zones devoted to cyber security and space and you'll learn how we're ensuring our technologies,

strategies and systems can take the strain in increasingly contested new domains.

However, at DSEI the kit is not the only star of the show. We're equally proud of our exhibition's partnership pull. In an uncertain age, our success depends increasingly upon international collaboration. We know we are better off when we work together: better off in terms of economies of scale and better off in terms of interoperability. And I know that by supercharging our capability across the domains - capability with civil as well as military applications - we will not just retain our position as the second largest Defence exporter globally but boost our prosperity, our skills and our jobs. And if you're looking to tighten global ties what better place to come than DSEI? Some 1,600 exhibitors from around 50 countries all gathered in one spectacular exhibition.

So I very much look forward to meeting you at our great Defence and Security showcase. Let's seize these opportunities - to strengthen old friendships, develop new relationships and weave that mighty tapestry of capability that will keep our people safe and prosperous for many years to come.





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# The United Kingdom's Integrated Review

**Conrad Waters**

In March 2021, the United Kingdom published three closely-linked documents that set out the Johnson administration's approach to British security and foreign policy in the decade ahead. Seeking to balance the post-Brexit "Global Britain" mantra with current political and economic realities, the new strategy sets out a vision of an energised and engaged nation helping to sustain an "open" international world order through a global military presence whilst building national advantage through innovation in science and technology. High in ambition but low on detail, the strategy risks being derailed by the many contradictions it seeks to reconcile.

Formally launched by Prime Minister Boris Johnson on 26 February 2020, the UK's Integrated Review of foreign policy, defence, security and international development has been claimed to be Britain's most fundamental reappraisal of national security strategy since the Cold War's end. In a statement to the House of Commons, Prime Minister Johnson summarised the review's objectives as being:

Photo: Crown Copyright 2019



*The aircraft carrier HMS in company with the Type 45 destroyer HMS. The Integrated Review envisages "Global Britain" bolstering its military presence on the world stage.*

- To define the UK's role in the world and its strategic aims for national security and foreign policy.

- To examine how the UK would be a burden-sharing and problem-solving nation, working more effectively with allies.
- To determine the capabilities needed to pursue national objectives and address the threats the UK faces.
- To identify the reforms required to government systems and structures to achieve these aims.
- To outline a clear approach to implementation and evaluation of the strategy over the coming decade.

## The Integrated Review: Process and Publication

During this period, the review's work was aided by two significant developments. One was the direction provided by publication of a new Integrated Operating Concept by the British Ministry of Defence in September 2020. Attempting to counter rival nations' exploitation of the ambiguous boundary between peace and war, the concept emphasises maintaining some forces focused on continuous operations to compete with the actions of rivals rather than always making warfighting capabilities the paramount aim. The other was the announcement of a relatively generous budgetary settlement for the British Armed

## Author

**Conrad Waters** is a naval and defence analyst based in the UK. He is Editor of Seaforth World Naval Review, Joint Editor of Maritime Security & Defence and a regular contributor to other Mittler Report publications

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Forces the following November. Promising a £24.1Bn (14%) increase in the defence budget over the following four years. This provided the financial stability that had been notably absent from previous British defence and security reviews.

When eventually published in March 2021, the outcome of the strategic review was essentially split into three elements. First out of the starting gates was the Integrated Review (IR) itself – Global Britain in a competitive age (CP403) – published on 16 March 2021. This was followed by a Defence Command Paper – Defence in a competitive age (CP411) – on 22 March 2021 that explained how the armed forces would be structured to meet the IR's overarching objectives. A third document – the Defence and Security Industrial Strategy (CP410) – released the following day has received less public attention but forms a fundamental part of the government's objectives. This sets out how the British defence industrial base will be supported in furtherance of the overall defence and security strategy.

## Strategic Conclusions

The principal conclusions of the IR are set out in Global Britain in a Competitive Age. The document commences with Prime Minister Johnson's vision for the United Kingdom in the 2030s. Inevitably full of political rhetoric and driven by national politics, this viewpoint is dominated by a desire to sell the advantages of a post-EU chapter in British history. This will see the benefits of the union between England, Scotland, Wales and Northern Ireland harnessed to allow a newly-freed UK to become "match-fit for a competitive world." Much is made of adopting an integrated approach – encompassing



Photo: Crown Copyright 2020

***Bravo Company, 40 Commando Royal Marine exercising with a Malloy Aeronautics drone in Cyprus. Britain's investment in new technologies is set to increase but the number of soldiers will fall.***

security, diplomacy, development and trade – to achieve this outcome. There is also a heavy emphasis on driving national prosperity through leadership in science and technology, not least in tackling climate change and biodiversity loss. Considerable attention is paid to assessing the environment relating to national security and international relations in the coming decade. Interestingly – despite political withdrawal from Europe in favour of a more global approach – the IR identifies the Euro Atlantic region as remaining critical to British security and prosperity. Moreover, Russia is viewed as remaining the most acute direct threat to the UK. This apparent contradiction

is justified by the assertion that global political and economic power will continue to shift eastwards to the Indo-Pacific. In comparison with Russia, the view taken of China – a "systemic competitor" – is more nuanced. This likely reflects the difficult balance between economic and security interests.

## Four Objectives

The IR sets four specific strategic national security and international policy objectives for the immediate future. These are:

- Sustaining a strategic advantage through science and technology: This essentially recognises that countries that



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***The Integrated Review identifies Russia as the most acute direct threat to the UK. Here, a Royal Air Force TYPHOON moves to intercept a Russian Tu-95 BEAR approaching British air space.***

establish a leading role in critical and emerging technologies will be at the forefront of global leadership.

- Shaping the open international order of the future: This reflects the view that the UK's openness to the flow of trade, capital, data, ideas and talent is essential to long-term prosperity and that – in a competitive environment – the UK must be more proactive in preventing rivals from determining how the world order that supports these flows functions.
- Strengthening security and defence at home and overseas: This effectively involves strengthening the capabilities of the armed forces to counter state threats to home security whilst allowing a more robust approach on the international stage.
- Building resilience at home and overseas: Reflecting the impact of the COVID-19 crisis, this looks at addressing the root causes of risks to the UK in the context of the transnational nature of many challenges and increasing the

Photo: Crown Copyright 2007



***The VANGUARD class strategic submarine VIGILANT pictured at HM Naval Base Clyde, Faslane. The Integrated Review reverses previous reductions to Britain's nuclear posture.***

nation's readiness to withstand such crises when they occur.

A number of unifying strands run through these objectives. These include the emphasis on trade and technological advancement to secure Britain's global position. Equally important – and reflecting some of the analysis behind the Integrated Operating Concept – is a focus on international engagement and forward presence to promote British interests on the world stage. This encompasses a strengthening of the United Kingdom's diplomatic presence and the expansion of a network of global hubs to project Britain's military influence.

### **The Impact on the Armed Forces**

An important aspect of the IR is the impact its overall conclusions have had on the future force structures and equipment of the British Armed Forces. Although much of this detail had to wait until publication of Defence in a competitive age, one highly significant change announced on 16 March related to changes in the posture of the UK's strategic nuclear deterrent. The 2010 Strategic Defence and Security Review (SDSR) mandated a reduction in British nuclear warheads to no more than 180, of which no more than 120 would be operationally available, by the mid-2020s. This policy has been reversed, with a nuclear stockpile of up to 260 warheads now being planned. Moreover, in an extension of a policy of deliberate ambiguity, public figures for the operational stockpile, deployed warhead or deployed missile numbers will no longer be provided. This policy change has been contentious, particularly since no justification has been provided beyond the evolving security and technological environment. There has been much speculation about the underlying reasoning, with the growing potency of ballistic missile defence systems perhaps one key factor in the decision. The IR makes no changes to the replacement of the existing quartet of Trident-armed VANGUARD class submarines with an equivalent number of DREADNOUGHT type boats from the early 2030s.

Whilst Defence in a competitive age provides much information on the future of Britain's conventional forces, it is notably different from previous defence reviews in not including an explicit force structure – there is much less detail about the numbers attached to specific capabilities and units. This makes it more difficult to assess the trade-offs that have been made in terms of retiring old equipment to pay for new capacity. Taking a cynical view, it also means that it is more difficult to hold the govern-



ment to account in terms of the successful delivery – or otherwise – of their plans. In general terms, however, the main impact on the various branches of the armed forces can be summarised as follows:

## The Royal Navy

If there is a winner as a result of the IR process, this is indisputably the Royal Navy. The review continues to place the continuous availability of a carrier strike group formed around one of the two QUEEN ELIZABETH class vessels at the heart of maritime policy. It supplements this with the creation of two amphibious littoral response groups that will be based in the European and Indo-Pacific theatres and a strategy of forward deployment of light units. An ambitious programme of naval construction confirms all existing programmes whilst heralding, inter alia, an eventual expansion of the frigate force and introduction of a new class of amphibious multi-role support ships. Some short-term pain will be felt by early retirement of two of the ageing Type 23 frigates and the eventual withdrawal of the flotilla of manned mine countermeasures vessels, the latter replaced by unmanned and autonomous systems.



Photo: Crown Copyright

***Britain's network of military bases assume more importance under the Integrated Review, Here an Airbus A400M ATLAS transport aircraft is seen at RAF Gibraltar.***

## The British Army

Although the IR has resulted in an additional £3Bn of capital investment in army capabilities to add to £20Bn already planned, the British Army does less well out of the review process. Its fully trained strength will be cut from a target of 82,000 full-time soldiers to 72,500 (although it should be noted actual strength currently stands at only currently stands at around 76,000/76,000), the plan to modernise WARRIOR armoured fighting vehicles is abandoned and the fleet of CHALLENGER tanks will be reduced. The army has suffered both from a lack of a clear strategic

vision of its future role and a failure to secure the replacement of increasingly obsolescent equipment. The IR aims to provide the resources to achieve the necessary modernisation at the cost of smaller numbers. This will be accompanied by further restructuring to make a more useful force.

## The Royal Air Force

The outcome of the review for the Royal Air Force has been more nuanced. A number of aircraft types – including the oldest, Tranche 1 TYPHOON aircraft and HERCULES transporters – will be retired early and plans for

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**The British Army's fleet of CHALLENGER tanks will be reduced in numbers, helping to pay for modernisation of the remainder.**

an eventual purchase of 138 LIGHTNING II strike fighters look set to be reduced. However, the remaining TYPHOONS will be subject to a programme of spiral development of capabilities in conjunction with development of the new Future Combat Air System that will encompass both the manned TEMPEST aircraft and additional unmanned and autonomous aerial vehicles.

Beyond traditional elements of the armed forces, the IR retains the recent focus on the new domains of cyber and space, where an increasing proportion of the £6.6Bn allocated to research and development over the four years to 2025 is likely to be directed.

## The Industrial Context

The refresh of Britain's defence industrial strategy has been a frequently overlooked part of the IR but is a fundamental part of the overall process. Described as building on the outcomes of the IR and Defence in a competitive age, it replaces the "competition by default" approach that has typified British defence procurement over recent years. Instead, the new plan places greater emphasis on the importance of a sustainable industrial base for both security and economic reasons. Stating that, "We must not only ensure that our forces have the right kit and equipment, but that we maintain capabilities onshore to produce and support critical elements for our national security, and ensure that our supply chains are sustainable and resilient", the strategy will inevitably lead to a more protectionist stance to future procurement.

In spite of this shift, it is important to note that there is no agenda to close the British defence markets to all competition. Instead, a "flexible and nuanced" stance will be adopted where international competition will be used as appropriate but where other approaches may be preferred where this matches the national interest. The strategy adopts new terminology to guide when competition might not be allowed. "Strategic imperatives" – nuclear deterrence, submarines, cryptography and offensive cyber – are regarded as areas of industrial capacity that are so fundamental to national security that they must be maintained largely onshore. In addition, a wider range of capabilities required for "operational independence" will require the retention of core indigenous capabilities in areas such as systems integration, upgrades and critical components. A more proactive stance will be taken to establish industrial capability

priorities. An example of the new approach is provided by a revised naval procurement policy. Whilst not ruling out international competition in appropriate cases, it gives far greater priority to the national shipbuilding base than previously.

The strategy focuses heavily on supporting domestic industry through much closer collaboration in a wide range of areas. This ranges from enhanced information sharing on future requirements through to a renewed drive for exports, including new government-to-government commercial mechanisms. Collaboration with international partners remains important, with the role of multinational companies operating in the UK valued for the investment and employment opportunities that they bring.

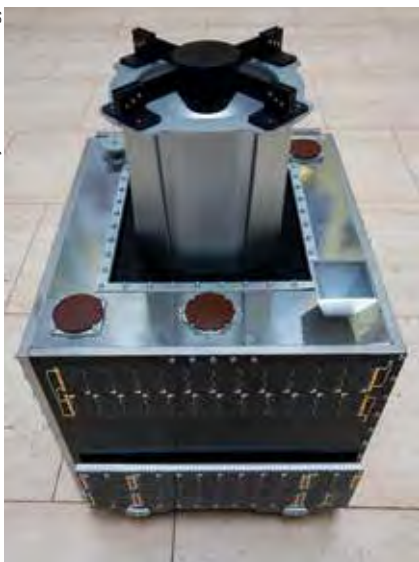
## Ambiguities and Contradictions

Whilst the IR attempts to provide a holistic and joined up approach to future British security needs, it is notable for some of the contradictions it seeks to reconcile. Prominent amongst these is the need to balance the recognition that the threat to European stability from increased Russian assertiveness is the UK's paramount security concern against the desire to grow British presence and influence in Asia. This quandary – arguably a direct consequence of Brexit – is at risk of producing an inherently contradictory approach under which limited military potential is being diverted to the Far East when there is an increased need to bolster defences closer to home. The ongoing uncertainty as to whether to treat China as a valued trading partner or a potential enemy only serves to add to this complexity.

Although backed by a meaningful increase in funding, the IR also follows the pattern of previous defence reviews in demanding immediate capability cuts in return for the promise of new, improved equipment in future. Some of the systems being retired – such as TYPHOON fighters and Royal Navy frigates – arguably provide capacity that supports the IR's security priorities. As always, there also has to be uncertainty over whether the promised new weaponry will be delivered in a timely and effective fashion. The problems afflicting the new AJAX armoured fighting vehicle would seemingly put the British Army at particular risk in this regard. The vagueness afflicting the information provided on future force structures that has already been mentioned provides additional ambiguity as to whether there will be a meaningful improvement in overall capacity.

Perhaps most surprising given the strategic imperative of shaping the open in-

Photo: Surrey Satellite Technology



**A model of the CARBONITE 2 Satellite, produced from collaboration between various government agencies and Surrey Satellite Technology. Improved collaboration between government and industry to drive the UK's national prosperity is one of the Integrated Review's objectives.**





Photo: Crown Copyright

departmental Conflict Security & Stability Fund to £0.9Bn during the current year.

### Conclusion

The IR represents an ambitious attempt to undertake a comprehensive review of British security requirements in the post-Brexit era. The broad sweep of its purview is arguably both a strength and a weakness. This facilitates a deep understanding of the many and varied factors influencing the national security environment at the expense of producing a complex set of conclusions that might prove difficult to put fully into practice. Many of the IR's results are welcome. The more stable funding environment; the linkage of security strategy with the Integrated Operating Concept; and the recognition of the strategic importance of the national defence industrial base are all positive developments. However, it is vague on important details and contains a number of important ambiguities. Most fundamentally, its attempt to reconcile the desire to create a "Global Britain" at a time when Europe remains fundamental to British security interests reflects the wider contradictions inherent in Brexit itself. ■

***Problems with the new AJAX AFV point to some of the risks inherent in withdrawing existing systems before the arrival of replacement capability.***

ternational order of the future is the fact that the IR process has coincided with a decision to temporarily reduce spending on international aid and development as a result of the financial strains caused by the COVID-19 pandemic. The amount budgeted for this assistance will fall from the

United Nations' target of 0.7% of Gross National Income (GNI) to 0.5% of GNI for an indeterminate period. For 2021, the cash impact of this reduction has been estimated at over £4Bn. A particularly noteworthy contradiction with stated IR aims is a reported c. £0.5Bn reduction in the cross-

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# Some You Win and Some You Lose – The Ongoing British Army Armour Crisis

**David Saw**

It had seemed that the British Army was finally getting its house in order as far as armoured vehicles were concerned. After years of programme cancellations, changing requirements, an inability to decide what was needed and failures to turn intentions into reality, real funded programmes had emerged. Perhaps, finally the British Army could look forward to obtaining new armour capabilities? Except it was never going to be that simple, as we shall see.

**B**efore we delve into the mechanics of what has gone right and what has gone wrong with the series of core armour programmes that the British Army has or intends to embark upon, a brief discussion of factors that impact the armoured vehicle environment will help provide some context.

Generation by generation, armoured vehicles have become more complex than ever before. Complexity is the breeding ground for programme delays, cost overruns and, as a worst case, programme failure. Unfortunately, complexity is inevitable. As the operational environment becomes more and more demanding, surviving on the modern battlefield and successfully completing the mission are going to require sophisticated solutions. The key is to find a solution with levels of sophistication and complexity that can actually be delivered on time and on cost, and that actually works as it should – and that is no easy task.

Unfortunately in Britain, there is another factor to take into account in discussing the problems in British armour programmes and that is the Ministry of Defence (MoD) itself, according to the National Audit Office (NAO) report, “Improving the performance of major equipment contracts - Ministry of Defence.” The report notes that the MoD “regularly experienced difficulties in effectively managing its major equipment contracts, with frequent delays and cost increases. These stem from supplier under-performance; weaknesses in departmental contract management; the Department and suppliers underestimating the scope and technical complexity; and the Department prioritising short-term solutions because of its affordability challenges.”

Photo: RTR



**A Royal Tank Regiment CHALLENGER 2 tank in Sennelager, Germany, prior to deployment to Estonia as part of the NATO Enhanced Forward Presence Mission.**

As an aside, the NAO report noted that, “Since 2018, the Department has been developing and implementing its Acquisition and Approvals Transformation Programme to improve the outcomes from its acquisition system.” That is obviously nice to know, but one wonders whether it has made a difference? To make matters worse, the NAO also states that, “the performance of the Department’s contracts must also be seen against a background of its unaffordable Equipment Plan.” Hardly comforting thoughts! On the other hand, the British government had stated in November 2020 that it will provide an additional £16.5Bn in defence spending over the next four years.

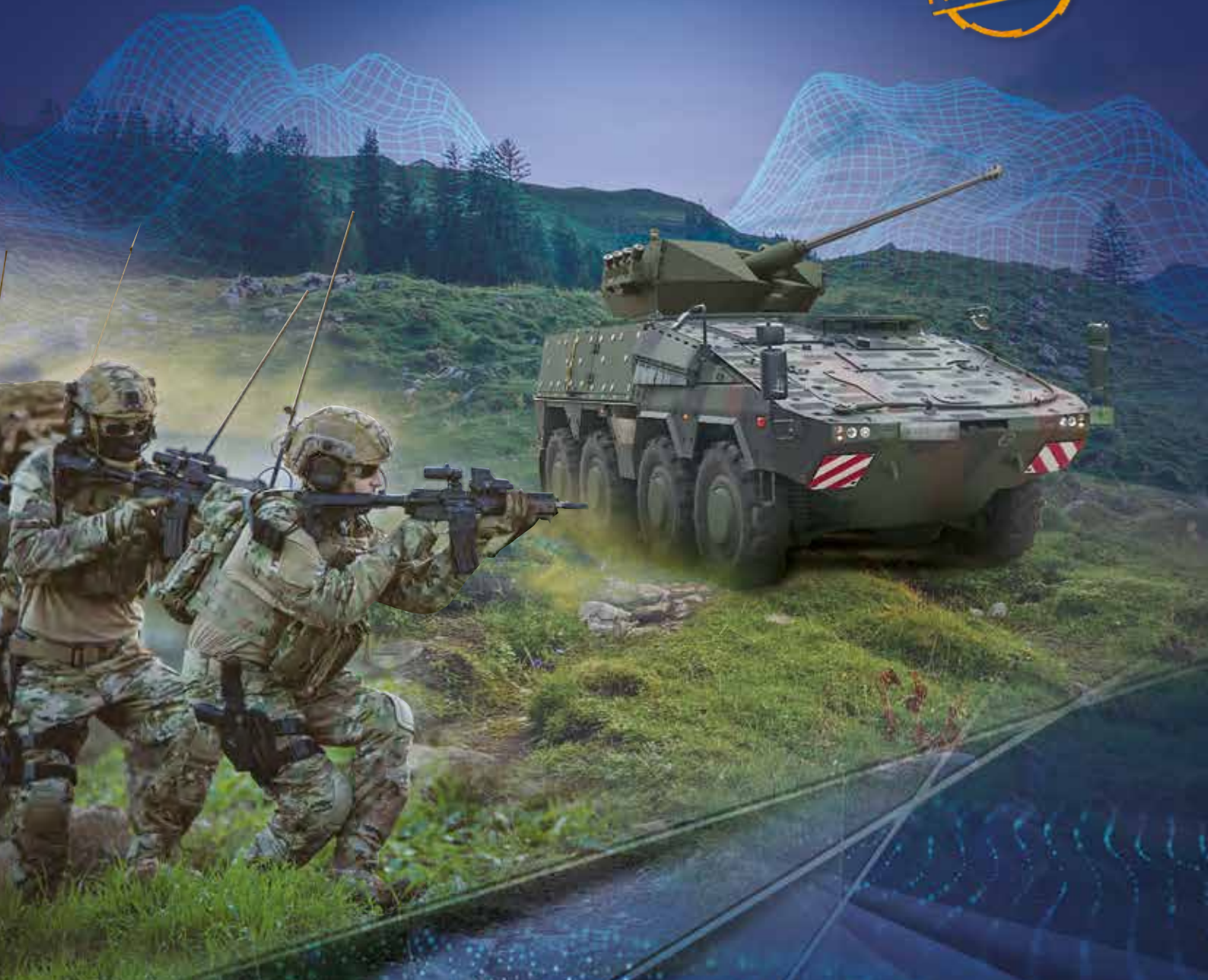
This sounds positive, but when government talks about value for money, competition, more flexible approaches and more agile procurement policies and processes, the fear is that it is just smoke and mirrors and that solving the procurement problem remains as far away as ever.

## Agony and AJAX

It has been a bad few months for the AJAX programme. To set the scene, the British House of Commons Defence Committee report “Obsolescent and outgunned: the British Army’s armoured vehicle capability” stated: “The AJAX programme, which is

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**In September 2014, GDLS-UK were awarded a contract for 589 AJAX vehicles for £5,522M. The programme is now running capability.**

now also seriously delayed, is yet another example of chronic mismanagement by the Ministry of Defence and its shaky procurement apparatus. This is particularly worrying, as AJAX is fundamental to the establishment and deployment of the Army's new Strike Brigades, which are intended to be a key part of its future order of battle." To put AJAX into context, in 2010 General Dynamics Land Systems-UK (GDLS-UK) were awarded a demonstration contract to meet the SCOUT Specialist Vehicles (SV) requirement. In September 2014, it was announced that GDLS-UK had been selected for the programme and would supply 589 vehicles in six different variants. A support contract was signed in 2015. Jeremy Quin MP, Minister of State for Defence Procurement sent a letter to the House of Commons Defence Committee in July this year disclosing AJAX costs, confirming that there is a 'Firm Price' contract, meaning that any costs over and above the agreed contract price are the responsibility of the contractor, with the contract valued at £5,522M. The

letter states: "As of June 2021, £3,167M (including tax) had been paid, covering Design, Development and Manufacturing activity, including vehicle development and trials, manufacturing, major assemblies, armour turrets and facilities."

The numbers of AJAX vehicles built as of June 2021 was 115, with 26 Capability Drop 1 vehicles having been delivered to the British Army for training. This is the number of vehicles required to achieve Initial Operating Capability (IOC). 12 of the vehicles delivered for training are equipped with turrets. Capability Drop 1 can be regarded as pre-series vehicles. The production standard will be Capability Drop 3 and once this is achieved, and fully deliverable, AJAX will be on the verge of Full Operating Capability (FOC), with Capability Drop 4 being the full specification in-service standard. AJAX has not achieved sign-off for IOC at this point. The programme is running late; new controversies have emerged, meaning FOC is further away than ever. GDLS-UK have stated that they have thus far manufactured

270 vehicle hulls and 60 turrets, According to GDLS-UK, AJAX offers "best-in-class protection and survivability, reliability and mobility, and all-weather Intelligence, Surveillance, Target Acquisition and Recognition (ISTAR), the AJAX Family of Vehicles (FoV) enable sustained, expeditionary, full-spectrum and network-enabled operations with a reduced logistics footprint." They continue: "Each AJAX variant has been future-proofed to ensure it can be upgraded quickly and effectively throughout its service. With a surplus payload capacity and an open Electronic Architecture that is stable, secure and safe, the AJAX FoV have extensive potential to combat future threats and incorporate the latest technology."

So, we have an extremely complex programme and, unsurprisingly, it is running late. However, the latest crisis to hit the AJAX programme is related to noise and vibration and how this has had health impacts on soldiers involved in the testing programme – a serious issue in itself, but one that has led to renewed focus on the cost of the programme and the fact that it is running late. Even worse for the MoD and the AJAX programme, all of this was played out in the media.

## Noise and Vibration

In July 2021, the Defence Committee heard oral evidence on "AJAX: Recent Developments." As might be imagined, the noise and vibration issues were front and centre in the questions that the committee asked. Scott Milne, Executive Programme Director, GDLS-UK, responded on the noise/vibration issue: "From the very start of the programme, we took an ASCOD platform, which was the point of departure, and characterised the noise and vibration values that it would generate. Those were within legislative limits as seen in an operational vehicle. Throughout the development phase of the programme, through the seven prototypes and for each production variant, we have tested the noise and vibration levels of the platform. Those levels are comparable to other armoured fighting vehicles within the GD family and in service today."

Obviously, sources of noise and vibration in an armoured vehicle primarily come from the engine and the running gear. The aim is to attenuate this noise and vibration. Noise levels must also be controlled to allow the crew to communicate within the vehicle and with external sources. It also became clear that the noise/vibration issue was not a recent phenomenon. As far back as 2017, stories were circulating on this subject, including the suggestion that the noise/vibration interfered with the stabilisation of the



**The AJAX ISTAR variant is equipped with the CTA International Case Telescoped Armament System (CTAS) 40mm CT cannon. This image comes from the AJAX firing trials. The AJAX programme is beset with difficulties due to noise and vibration impacts on crew health.**





gun in the turret and also with electrical systems.

In May 2020, the MoD commissioned a report from the Institute of Naval Medicine (INM) on noise/vibration. Work commenced in August and an interim report was submitted in September. This was considered as "inconclusive," and further reports were undertaken by the Army and the Defence Science and Technology Laboratory (Dstl) and this led to AJAX trials being halted in November 2020.

The Minister of State spoke to the Defence Committee on what happened next: "Work was undertaken into how trials could resume safely. Having reissued a safety case in March 2021, which had a number of changes, including new forms of hearing protection, a speed limit being imposed, activities being conducted in a way to reduce noise, the serials spread over a longer period of time and/or more frequent crew changes, it was deemed possible for trials to resume under that new safety case. However, when it was identified that there was renewed concern regarding hearing loss, they were again paused. They have not resumed. They will only resume when we are absolutely certain, or as certain as we ever can be, that there will not be another safety incident."

As to the medical issues related to the AJAX trials programme, Major General Hodgetts, the Surgeon General, told the Defence Committee that there had been nine formal reports on eight service personnel regarding vibration injury. In total, 296 service personnel and 11 civilians are involved in the AJAX trials programme. As regards noise-related injuries, the Surgeon General said that, "As of 16 July, we have fully assessed 110 people within the acute bracket, and, so far, there have been 28 episodes when hearing rescue was clinically indicated in 23 people. There have been five cases since last November where a second treatment has been indicated." Given enough time and enough money, the noise and vibration issues can be resolved. The danger is that so many negatives are starting to surround this programme that its long-term survival could be in jeopardy. The Minister of State said that, "I have described AJAX as a troubled programme — I wish that it wasn't, but it is — and it requires a lot of work from ourselves and our industry partners to get ourselves back on track. We can't be 100% certain that that can be achieved but this programme matters to the British Army, to 4,100 employees and to 230 companies across the UK, and we

will do our utmost to succeed." In response to another question from the Committee, the Minister of State replied, "With every procurement there are a large number of decisions that need to be made, and need to be made accurately. It is too early to tell where the problems lie. I would love to tell you, but I have confidence that we will find a solution very quickly and get on with it. Hopefully, that will be the case. I don't personally see us hitting FOC as early as 2025, although that may be possible."

## The End of WARRIOR

The British Army currently has 767 WARRIOR vehicles. Back in 2009, work began on the WARRIOR Capability Sustainment Programme (WCSP), with contract award to Lockheed Martin UK in 2011. WCSP was a key component of the Armoured Infantry 2026 programme. Its aim was to extend the Out of Service date for the platform from 2025 out to 2040 and beyond. The aim of WCSP was to upgrade the platform to address what were described as "short-falls" in fightability, lethality, survivability, growth potential and safe operation. According to the NAO, the WCSP programme was running 56 months late.

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**The VILKAS is the version of the BOXER in service with the Lithuanian Armed Forces. In 2019, Britain ordered 508 BOXER vehicles in four variants.**

Even worse, it was £227M over budget. In March of this year, the programme was cancelled. This was despite the fact that great efforts had been made to get the programme back on track and the 80% of test points had been reached. There was just no confidence that WCSP could be delivered. The reasoning behind WCSP was that the Army saw major gaps in its manoeuvre capability; now those gaps will undoubtedly get worse. It seems that a partial solution to the manoeuvre capability gap will be the acquisition of more BOXER vehicles (see below), though a tracked vehicle would be a more appropriate solution, even via a partial purchase, to replace WARRIOR.

### The Favoured Child - BOXER

The NAO report has plenty of positives to report on the BOXER programme, noting that the programme is running ahead of schedule and that forecast cost is down by four percent. BOXER was selected to meet the British Army Mechanised Infantry Vehicle (MIV) requirement for an 8x8 wheeled armoured vehicle. In 2019, a £2.8Bn con-

tract was awarded via the Organisation for Joint Armament Cooperation (OCCAR) to ARTEC (the Rheinmetall and KMW consortium) for 508 vehicles in four variants. First deliveries are on course for 2023.

The MIV requirement called for a second batch of BOXER vehicles to be acquired, with the number of 300 being spoken of for this second batch. Now, with WCSP cancelled, BOXER is being suggested as a solution to replace the WARRIOR when it goes out of service. The question is will the new requirement for additional BOXER be added to the proposed add-on to the MIV contract or instead of it. In the meantime, everybody is happy with BOXER, the Defence Committee commented: "We welcome the decision to procure the BOXER armoured vehicle for the British Army, albeit more than ten years later than would have been the case had the UK stayed in the original multi-national consortium."

### The BULLDOG

As an aside, there are still 891 BULLDOG/FV430 series vehicles in service. These originally entered service in the

early 1960s, with production ending in 1971, with thousands built. From 2006 onwards, some FV432 were upgraded to the BULLDOG configuration to meet requirements for operations in Iraq. The replacement for these venerable vehicles is known as the Armoured Support Vehicle and is due to come online at the end of the decade. One cannot fail to be impressed by the longevity of the FV430 series, yet by the time they are replaced the youngest vehicles in the fleet will be 60 years old!

### The CHALLENGER 3 Arrives

The CHALLENGER 2 was first delivered in 1998, with 386 tanks and 22 Driver Training Tanks (DTT), with deliveries complete in 2002. Also in service using the CHALLENGER 2 chassis are 33 TITAN AVLB and 32 TROJAN AVRE, while the standard ARV, the CRARRV, uses the CHALLENGER 2 powertrain. Current fleet numbers for CHALLENGER 2 gun tanks are 227 vehicles.

There had been a number of efforts to upgrade the CHALLENGER 2. These were thwarted by cost considerations and by a growing body of opinion that perhaps the age of the tank was over. Eventually, it was decided to go ahead with an upgrade programme known as the CHALLENGER 2 Life Extension Programme (CR2 LEP), with assessment contracts being awarded to BAE Systems and Rheinmetall in 2016 (in June 2019 a joint venture company, Rheinmetall BAE Systems Land (RBSL), was formed and they would become central to the upgrade programme). The thinking was that going ahead with CR2 LEP was the best solution on performance and cost grounds, rather than the alternative of acquiring a new tank from either Germany or the US. Another factor was that a new tank would have meant replacing the DTT, ARV, AVRE and AVLB that are all based on the CHALLENGER 2 chassis or powertrain.

From its starting point in 2015, the CR2 LEP programme grew in scope. This was no longer a limited upgrade, it was a much more serious proposition. The NAO report noted that there has been a 69% increase in forecast costs for the programme between 2015 and 2021. The CR2 LEP programme would eventually evolve into the CHALLENGER 3 and on 7 May 2021, RBSL were awarded an £800M contract to upgrade 148 CHALLENGER 2 tanks to the CHALLENGER 3 configuration.

Assuming that CHALLENGER 3 will keep to the same Key Performance Milestones as CR2 LEP, the tank will be ready for trials in May



**There are 767 WARRIOR vehicles in service. The aim of the WARRIOR Capability Sustainment Programme (WCSP) was to extend the service life of the vehicle. In March 2021, the WCSP programme was cancelled, at which point it was 56 months late and £227M over budget.**





2024 and ready for manufacturing in July 2025. Ready for training is due in June 2027; IOC is November 2027 and FOC is November 2030. However, unless extended, Out-of-Service Date still remains at 2040.

The CHALLENGER 3 upgrades the three critical armour areas in terms of firepower, protection and mobility. A new turret mounts a Rheinmetall L55A1 120 mm smoothbore gun, for which Rheinmetall can offer improved APFSDS rounds. The new DM73 round offers an 8% performance increase over the existing DM53/DM63 rounds, with the new KE2020Neo round, available in 2026, offering a performance increase of more than 20%. Commander's and Gunner's sights are improved, tactical communications are improved, with increased electrical power and an electronic architecture with growth potential added.

Protection enhancements include a new modular armour system developed in the UK, with the Rafael TROPHY being selected to provide an APS capability. Mobility will be improved under the Heavy Armour Automotive Improvement Programme. The engine will be upgraded to the CV12-8A configuration, with specified maximum power increased to 1119 kW. In



Photo: RBSL

**In May 2021, Rheinmetall BAE Systems Land (RBSL) were awarded an £800M contract to upgrade 148 CHALLENGER 2 tanks to the new CHALLENGER 3 configuration.**

addition, there are suspension improvements. These mobility upgrades will also be applied to other systems using CHALLENGER 2 chassis.

### Outlook

Of the four future main armour programmes for the British Army, BOXER looks primed for success and CHALLENGER

3 ought to be a success, AJAX could be in jeopardy and the WCSP WARRIOR upgrade was cancelled. What is so frustrating is how much money has been wasted on armour programmes in Britain over the years, with so little to show for it. Government, the MoD procurement bureaucracy, the military and industry have to do better. Whether they can or not still remains a question without an answer. ■

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# Building a New Reality

## The British Defence Industrial Strategy

**David Saw**

**Britain has a long-standing problem with an ineffective defence procurement culture. This has seen vast sums of money wasted and many of the benefits of technology development lost. The UK government wants to put an end to this mismanagement.**

On 23 March 2021, the British government issued a new Defence and Security Industrial Strategy (DSIS). According to the government, "Building on the outcomes of the Integrated Review and the Defence in a competitive age Command Paper, the Defence and Security Industrial Strategy (DSIS) provides the framework for government to work with industry to achieve those ambitions; driving innovation and improvements in productivity to ensure that the UK continues to have competitive, innovative and world-class defence and security industries that underpin our national security and drive prosperity and growth across the UK."

The official description of the origins and aims of the DSIS states that, "This new strategy is the result of a cross-Government review, led by the Ministry of Defence but with input and expertise from other government departments. It sets out a package of policy, process and legislative change across key areas of acquisition and procurement, productivity and resilience, technology and innovation, and international collaboration, exports and foreign investment. The DSIS positions the UK's defence and security industries as strategic capabilities in their own right, and sets out specific approaches to the particular capability and technology segments that are most important to the UK's national security."

The DSIS would seem to suggest that the British government is finally taking the strategic and economic contribution of the British defence industry very seriously indeed. Unfortunately, it is very easy to be cynical about government recognition of the importance of the defence industry. Previous experience has indicated that government and the defence procurement bureaucracy have been less than supportive of the industry, often viewing it as obstacle rather than an asset. Then there is the sad fact that the British government has proven itself to be less than effective in terms of managing defence programmes to deliver the desired capability on time and on cost.

Photo: BAE Systems



**In late July, the MoD signed a £250M contract with British industry "Team TEMPEST" partners to progress to the next next phase of the TEMPEST Future Combat Air System (FCAS) programme. The evolution of the TEMPEST programme will be a test of the new Defence and Security Industrial Strategy (DSIS).**

To be fair, government is not the only source of mismanagement in defence procurement. Industry must take some of the blame, as must the end user. Frankly, Britain has a long-standing problem with an ineffective defence procurement culture. Added to this is the impact of programme cancellations on political grounds. This has seen vast sums of money wasted and many of the benefits of technology development lost. As if that were not enough, these programme cancellations have also weakened the national defence industry. If the DSIS delivers a strategy that can sustain the defence industry and critical capabilities that will be a change for the better. However, eventually somebody is going to have tackle reforming the procurement system, as this will remain a failure point in the industrial strategy.

### The Years of Decline

It could be argued that the first time that Britain truly had modern defence industrial policy was the establishment of the Ministry of Supply (MoS) in 1939 to supply equipment to British forces. The MoS was in charge of state-owned ordnance factories, its own factories and Army research establishments. Post-1945, the MoS took charge of the Ministry of Aircraft Production covering the aircraft industry and all aviation-re-

lated research establishments. It headed up missile programmes and was also responsible for British nuclear weapons programme. The MoS was closed in 1959 and many of its function were eventually absorbed into the Ministry of Defence (MoD).

The problem was that post-1945 Britain had far more defence commitments than it could actually afford. It had immense financial problems and really needed to rationalise its defence industry to focus on areas that were critical to national defence. The 1957 Defence Review was the starting point for a series of efforts that continued through the 1960s, to match military commitments to actual resources and to save money. As a part of that, numerous defence programmes were cut and defence industrial capabilities lost. It was defence rationalisation but it was surgery with an axe rather than a scalpel! Making things worse in those defence procurement programmes that did go ahead, were the numerous incidents of mismanagement leading to cost overruns and reduced capability. There was also the impact of nationalisation across the aircraft and shipbuilding industries in the 1970s. This might have made sense in terms of ideology, but in reality was another pointless and costly move. There would have been more cuts if the 1981 Defence Review had come into effect but the 1982 Falklands Conflict put a stop



to that. The real problem was that there appeared to be no integrated strategy covering what procurement requirements were and how they could best be met. Everything was done on a case-by-case basis and inefficiencies were rife.

Despite all of these negatives, the defence industry was still a force to be reckoned with. There was the British Army Equipment Exhibition (BAEE) held at Aldershot and the Royal Navy Equipment Exhibition (RNEE) held at Whale Island, Portsmouth, running in alternate years and, of course, the Farnborough Airshow. Attending one of these events in the mid to late-1980s, the number of British defence companies on show and the diversity of their capabilities was extraordinary. Just in terms of major defence electronics companies, you had Ferranti, Marconi, MEL, Plessey, Racal and Thorn-EMI amongst others. The problem was that by this time, Britain had a Cold War defence industry, when the Cold War ended and defence expenditure was reduced that inevitably meant a new wave of industrial rationalisation. There were too many companies chasing too few orders.

A happened elsewhere in the US and western Europe, bit by bit old established names in the defence industry would disappear as



Photo: Ministry of Defence

**Earlier this year, the British government announced a programme to upgrade 148 CHALLENGER 2 tanks to the advanced CHALLENGER 3 configuration, an extremely welcome development for British Army armour capabilities. The whole CHALLENGER 2 upgrade effort took far too long to become a reality, the requirements and procurement process in Britain needs reform.**

they were described as “legacy companies” and absorbed within larger organisations. The British government saw this process of industrial consolidation as a positive development. What they did not do was look to keep sovereign capability in key areas. Of that list of defence electronics companies shown above, the majority would end up as part of Leonardo, headquartered in Italy, or Thales, headquartered in France.

### The Industrial Landscape

Industrial consolidation was inevitable. What was potentially avoidable was the loss of British capability in a number of key areas. The decline of the British automotive industry is a case in point. There were a number of fac-

tors involved in this and defence was not one of them. The end of this decline did impact on defence, leading to the virtual disappearance of the British truck industry. Moving up the scale in terms of value and sophistication comes armoured vehicles; at one stage you could look to Alvis, GKN and Vickers as onshore suppliers of capability. Now these are all part of Rheinmetall BAE Systems Land (RBSL), a joint venture company announced in 2019, that will provide armoured vehicle design, development and support.

On the other hand, while these first-line manufacturers might have disappeared, other companies have developed to meet defence requirements. Pearson Engineering is best known for its combat engineering equipment, but it is also involved in sup-

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## COUNTRY FOCUS: THE UNITED KINGDOM

porting the CHALLENGER 2 tank fleet. Their Defence Manufacturing Services activity, ironically based at the Armstrong Works in Newcastle upon Tyne, purchased in 2013 and reopened in 2015, was where Vickers had built generations of British tanks, offers a complete range of services from MRO and support to manufacturing, assembly, integration and test (M-AIT). Perhaps future generations of British Army armour could yet leave the gates of the Armstrong Works? As stated earlier, it is easy to be cynical about the new DSIS, yet the right noises are being made. The foreword to the DSIS states that, "We must not only ensure that our forces have the right kit and equipment, but that we maintain capabilities onshore to produce and support critical elements for our national security, and ensure that our supply chains are sustainable and resilient. Through targeted investments we can deliver not only the right equipment but can bolster the Union, deliver on levelling up and enhance the skills and prosperity of the United Kingdom." It also notes that, "In addition to MoD and Armed Forces personnel, Defence alone already supports over 200,000 jobs directly and indirectly and tens of thousands of apprentices."

More concretely, the DSIS promises a "substantial injection of new funding, including at least £6.6Bn in Defence Research & Development over the next four years, [that] directly generates growth and development of new technology, created and commercialised in the UK for strategic advantage." This positive development leads to even more positive developments: "Companies, informed by government's clear statements of its national security needs, plans and technology priorities, and understanding better how government evaluates industry's offers, have the confidence to invest themselves in developing new technology, products and services and improving productivity." DSIS will create an environment where "the government works more closely with industry to develop the equipment capability it needs, considers the export and international collaboration opportunities earlier, and supports industry more effectively (including where appropriate by entering government-to-government commercial agreements) to increase export market share still further, achieving economies of scale, sustaining the skills base... beginning the cycle again by encouraging further reinvestment in R&D, skills and equipment, driving productiv-

ity and competitiveness even further." Along with this comes regulatory reform to simplify processes and increase efficiency, again lots of positive messages. If DSIS delivers what it promises it could transform the defence industrial environment in the UK, while making a major contribution to the British economy and the development of its technology base. DSIS seems to offer a "win-win" situation to all of those involved, and historically, the relationship between the British government and the British defence industry has never led to a "win-win" situation for any of those involved!

To make all of this work, the politicians, the MoD, the procurement bureaucracy, the military and the defence industry must all work together. There has to be an open, honest and collaborative relationship amongst stakeholders whose relationships currently can most often be described as adversarial. Get that right and DSIS has a chance! Equally as important is that all of those involved manage to somehow develop effective programme management tools and practices. All too often, this has been the downfall of British defence programmes. DSIS has so much to offer, if it works...

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**Major General  
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Director of Acquisitions of  
the Army Logistics Support  
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# Raytheon UK: Pushing the Boundaries

Photo: Raytheon UK



**Jeff Lewis, CEO and Managing Director, Raytheon UK**

**The merger between United Technologies and Raytheon Company took place as the Covid pandemic was in its early days. Raytheon UK is one of the UK-based companies within the new Raytheon Technologies, and ESD had the opportunity to meet Jeff Lewis, CEO and Managing Director.**

**ESD:** Following the merger, what does the overall structure of Raytheon look like, and how does Raytheon UK sit within that structure? How does the corporate structure impact Raytheon's approach to the UK, as a partner, as a customer and as a home?

**Lewis:** We celebrated in April the 1-year anniversary of the merger of United Technologies and Raytheon Company to form Raytheon Technologies. The company now consists of Collins Aerospace Systems, Pratt & Whitney, Raytheon Intelligence & Space and Raytheon Missiles & Defense. The company delivers solutions that push the boundaries in avionics, cybersecurity, directed energy, electric propulsion, hypersonics, and quantum physics. Raytheon UK sits within the Raytheon Intelligence & Space business, and is part of the Raytheon Technologies enterprise in the UK, which consists of Collins Aerospace and Pratt & Whitney, supporting over 7,000 employees in country. However, we work in partnership with all of the businesses and not just the business we sit within; as a result of the merger we have developed a closer working relationship with Collins Aerospace in the UK for instance, giving us a window into their portfolio of products that has enabled us to work together on a number of opportunities, bringing our experience and expertise to work together for our customers.

Raytheon UK has 2,000 people across the country. We work on a wide portfolio of products that we design, develop and manufacture within the UK such as GPS, AJ, Cyber Intelligence. And we also work in partnership with our US colleagues, where we may adapt and evolve their technology for UK requirements. Finally, we have a strong manufacturing capability in the UK, working on subsystems and products for export market and into major platforms. As a prime contractor for the Ministry of Defence, working in weapons and sensors and cyber, space and training solu-

tions, our work is focussed on providing solutions to our customers' challenges across all domains of air, land, sea, underwater and space.

Similarly, Collins Aerospace employs about 5,000 people in 20 locations and supports a further 12,000 jobs through its supply chain. Collins designs, develops, manufactures, and supports a comprehensive range of solutions for global defence customers, integrators, aircraft manufacturers, airlines, business-jet operators, and many other customers worldwide. It also brings affordable and disruptive technologies and capabilities to the region by col-



Photo: Royal Navy

**Raytheon UK and partners won the Project Selborne contract to provide training for the Royal Navy.**



# Where we operate

## Raytheon UK Locations

- 1 **GLENROTHES**  
Engineering Design and Manufacturing Centres of Excellence
- 2 **LIVINGSTON**  
Advanced manufacturing
- 3 **SALFORD, GREATER MANCHESTER**  
Cyber Centre
- 4 **RAF WADDINGTON**  
Airborne ISR Training and Support
- 5 **BROUGHTON**  
Aircraft Integration and Modification Support Centre
- 6 **GLOUCESTER**  
Cyber Innovation Centre
- 7 **HARLOW, Raytheon UK Headquarters**  
Technology Centre of Excellence
- 8 **LONDON**  
Technology Centre of Excellence
- 9 **WARMINSTER – CAST (Army Training Branch)**  
Specialist service and training support to MOD training
- 10 **MIDLAND, ONTARIO, CANADA**  
Design and manufacture of optical solutions



Please note only major facilities listed

laborating with the European aerospace and defence industry.

Our history in the UK is long. Raytheon Technologies' contributions to the UK economy benefit every region across the UK, according to our 2019 statistics. I believe that our transatlantic ties, between Raytheon Technologies and Raytheon UK make us stronger: we are developing home grown technologies, at home, and delivering innovative technologies and R&D from the United States.

**ESD:** Given the intention to increase Raytheon UK's impact on the UK economy, is that driven from Raytheon USA, or from the UK?

**Lewis:** Raytheon Technologies' commitment to the UK – and track record of bringing prosperity to the UK economy – make the company an ambitious and reliable partner for the future. In 2019, Raytheon Technologies' contribution to the UK economy was estimated to be £2.7Bn with a spend of over a billion with UK suppliers for domestic and export work. For every Raytheon Technologies job created another four are sustained in the UK supply chain. As a British technology company, my role as CEO for Raytheon UK is to grow our presence and continue to expand our portfolio. We set the strategy in the UK for our customers and partners, and are supported by the businesses with R&D and technology, to ensure close alignment and help grow our business in our existing and new markets. We are investing in the UK in the long term so we can drive innovations, as we have done previously in intelligence, surveillance and

reconnaissance, power products for defence, cyber security and now transformative training. For example, our recent partnership with Capita for Project Selborne is helping us deliver real transformative training to the Royal Navy.

**ESD:** What about Raytheon's current and short-term investment in the UK? What effect has Brexit had, and are there any lessons learned so far regarding Brexit?

**Lewis:** Brexit has not had the impact on our company in Raytheon UK as it may have had in other sectors and firms. Our leading export markets for the UK are primarily the USA and Middle East. Over the years we have developed a strong manufacturing base across the entire country, developing specialised and highly complex products across Scotland and in England. We are now an integral and important supplier of systems and products for Raytheon Technologies' global supply chain. We are now in the process of developing a new factory in Livingston, Scotland; a fully digital factory that will serve our new markets.

**ESD:** For a number of years Raytheon has embraced corporate social responsibility, particularly in the USA regarding women in the workplace and STEM in education. How do those American corporate values translate to the UK?

**Lewis:** We share the same common values between the USA and UK. Whilst there are some distinct differences in the way we may tackle diversity and inclusion in the work-

place, due to cultural differences, the overall objective is to have increased diversity in our workforce, and ensure everyone feels included. We succeed when our best talent works together, and when there is a diversity of opinions and experiences in the room – otherwise, innovation is stifled.

One of things we are deeply involved in is Forward Steps. In the UK, we established Forward Steps to help people to take that positive step forward, whether it be in their careers or lives. As a former apprentice I understand the importance of the right experience and opportunities, and Forward Steps supports groups by helping to close the STEM skills gap, bringing courses and skills training such as in cyber to help inspire more to take on STEM-related roles. For instance, our flagship Quadcopter Challenge sees us working with local schools and cadet units to give them the opportunity to design, develop and manufacture a quadcopter and fly it at the end of the challenge in front of a team of experts. Our umbrella programme is also supporting Britain's Armed Forces and veterans to transition into new careers post service, and supports our local communities to share in our economic prosperity. 2020 saw us launch our volunteering activities in earnest, and we are supporting every employee who wants to make volunteering part of their community effort with us.

**ESD:** Thank you.

**The interview was conducted by Stephen Barnard**





# Exporting Maritime Britain

Photo: Crown Copyright



**Mark Goldsack is the Director of the United Kingdom's Department for International Trade Defence and Security Organisation (DIT DSO).**

Accounting for only four percent of United Kingdom defence and security exports in the decade to 2019, the naval sector has typically enjoyed a lower profile than other aspects of British defence sales. However, things are changing. Export success in the form of the sale of the Type 26 Global Combat Ship design to Australia and Canada has combined with a new emphasis on exportability typified by the Type 31/ARROWHEAD 140 frigate to give the maritime segment new importance. MSD spoke with Mark Goldsack, Director of the Department for International Trade UK Defence and Security Exports about the United Kingdom's recent emphasis on securing naval exports and the country's future plans for the sector.

**ESD:** Naval exports have formed only a relatively small part of the United Kingdom's overall defence and security sales during the last decade. Given this background, what accounts for the current focus on this market segment?

**Goldsack:** In recent years much of the United Kingdom's success in defence and security exports has related to fast jet aircraft, reflecting the type of equipment our own armed forces have been acquiring. However, the Royal Navy is now undergoing a major process of recapitalisation, investing significant sums in a large number of different types of new warships. Fortuitously, this period of investment in our own fleet

**Mark Goldsack is the Director of the Department for International Trade UK Defence and Security Exports. He is responsible for maximising British defence, security and cyber exports, as well as attracting foreign direct investment in these areas. Before joining the department in January 2019, Goldsack spent over 30 years in the British Army. There he held a variety of senior roles, particularly in the defence engagement capability and equipment areas in the UK and overseas. Goldsack holds a BA (Hons) in History from the University of York, an MA from Cranfield and an MSc and MPhil from the University of Madras.**

is coinciding with a cyclical upturn in global naval procurement, an event which only occurs roughly every 30 years. We see this situation as providing massive opportunities to build long term relationships with countries with similar naval requirements to our own. We recognise that we will only be successful if these relationships are based on a "win-win" basis and are particularly looking to work with our friends and allies around the world to share our own knowledge and expertise to mutual benefit.

**ESD:** What is different to the United Kingdom's current approach to naval exports compared with how the market was addressed in the past?

**Goldsack:** There are a number of differences. First, we now have a sound strategic foundation to our endeavours through the work that has been undertaken to develop both a Defence and Security Industrial Strategy and a National Shipbuilding Strategy. These two documents focus on the conditions required to achieve export success, not least the emphasis on partnership I have already mentioned. In addition, we are now able to work more cohesively across government than ever before to fashion compelling offers that draw on the wide-ranging and unique advantages the United Kingdom has to offer our partners, be they diplomatic, industrial, financial or the unparalleled training and developmental support the Royal Navy is able to provide. In short, we are able to tailor and scale an offer that is focused on a partner country's particular circumstances and both the security and economic objectives they are looking to achieve.

**ESD:** What relevance does the traditional model of selling ships have to the United Kingdom's future naval export model, particularly given much of its recent success has been in equipment, designs or other services?

**Goldsack:** We see both platforms and also the wider naval sphere as being important export targets. We are determined to be able to offer platform-based options out into the global naval market and believe – perhaps for the first time in a generation – that we currently have a compelling offer in this field. For example, the Type 31 frigate was designed with exportability being a fundamental part of its specification. Its ARROWHEAD 140 parent design has the potential to be a genuine market disruptor, both as a result of the modular capability it is able to provide and also due to its competitive price point compared with rival ships. Of course, we also recognise the substantial value that resides within the supply train and wider support services. What is most important is that we are able to offer what the customer needs, ensuring the maximum opportunity for flexibility of build, industrial benefit through technology transfer and an effective support solution; all at the most competitive price.

**ESD:** Given the competitive nature of the United Kingdom's own naval industrial sector – with a number of British companies potentially offering similar products – how can you ensure export campaigns are coordinated to the greatest advantage of 'Team UK'?

**Goldsack:** That's an important question. If we were simply to step back because a particular opportunity was subject to rival offers from British companies, the inevitable result would be that a foreign competitor



Photo: Crown Copyright 2021



***A Eurofighter TYPHOON fast jet overflies the Type 23 frigate HMS NORTHUMBERLAND in 2018. Aviation exports have dominated British defence exports in recent years but there is a new focus on maritime systems as the Royal Navy and many international fleets embark on a period of recapitalisation.***

would win the contract due to their own government's support. One important part of the solution has been strengthened co-ordination – including the establishment of a cross-cutting Maritime Capability Campaign Office – to build a cohesive approach across government and industry. The aim has been to gain a shared view of the future market and take informed decisions of who is going to do what and where. Moreover, the enhanced situational awareness we are gaining from improved market intelligence should help to drive future investment decisions. We have already found that the way the market has stratified has allowed us to undertake a really complementary approach across industry to some campaigns. It's also important to note that the Aircraft Carrier Alliance – that built the two QUEEN ELIZABETH class aircraft carriers – has had an enduring legacy in making pan-industrial cooperation much more the norm than it was previously.

**ESD:** So how might this approach work in practice? For example, might you see one of the larger industrial companies take a lead 'Team UK' role in an export bid by fostering opportunities for smaller British suppliers?

**Goldsack:** Yes, I think that's certainly possible. More broadly, I think that there has been a growing acceptance that the health of the whole industrial ecosystem will need to be tended to or even the strongest participants will eventually wither and die. The large players recognise their responsibility in ensuring that this does not happen. This has been evident, for example, during the COVID-19 pandemic, where it's been noticeable that cash has continued to flow through to the smaller suppliers in spite of the inevitable strain that the entire industry has been under. I think that's a real demonstration of the collaborative ethos than now exists within industry.

**ESD:** The sale of the Type 26 Global Combat Ship design to Australia and Canada has been a notable British export success in the naval sphere. What lessons have been learned from this achievement?

**Goldsack:** Well, to be slightly "tongue in cheek", I'm not going to reveal all my top tips as I don't necessarily want the competition to benefit from them! However, succeeding in two genuinely open and arduous competitive processes has produced many valuable lessons in terms of understanding both our strengths and weaknesses. These have been fed into the Defence and Security Industrial Strategy and, at a more tactical level, been used to develop a "playbook" for government and industry to guide the conduct of future campaigns. I should also note that the fact that we were able to be successful in winning competitions evaluated to the most stringent levels to meet the demanding requirements of two leading navies has exponentially increased our own credibility, bolstering our chances of further export gains.

**ESD:** Are you able to be a little more specific about some of the factors that contributed to the United Kingdom's success in these two competitions?

**Goldsack:** I believe a fundamental part of our success was our ability to build on the close partnership we already had with the two purchasers of the Type 26 design, both members of the 'Five Eyes' intelligence sharing community. This was particularly helpful in making sure that we had a fundamental understanding of their specific requirements and tailored an offer to match. I should also note that an important element of our offer was the ability to work with BAE Systems Australia and Lockheed Martin Canada to maximise local content and the benefits of technology transfer, both fundamental objectives of the partner countries.

**ESD:** Turning to ARROWHEAD 140, could you say a little about the prospects for this export-driven design?

**Goldsack:** As I indicated previously, the ARROWHEAD 140 frigate is a genuinely disruptive design due to the adaptability and scalability that are provided by its modular characteristics. This gives us the opportunity to utilise the efforts we are making to understand customer requirements to provide a solution that can be truly optimised to the mission the customer navy is looking to perform. At the same time, the fact that ARROWHEAD 140 is derived from a fully tried and tested baseline design (editor: The Danish IVER HUITFELDT class) means that we can provide confidence in terms of reduced

Photo: BAE Systems



***The Type 26 Global Combat Ship has been a recent export success, with the design being sold to both the Royal Australian and Royal Canadian Navies.***



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Photo: Babcock International



**The ARROWHEAD 140 – parent design of the Royal Navy Type 31 frigate – is the object of a number a number of ongoing export campaigns.**

programme risk and known operating costs. We are delighted with the level of international interest this modern, flexible frigate is already generating.

**ESD:** How will the refresh of the National Shipbuilding Strategy feed into your own export efforts?

**Goldsack:** We have been working very closely with the Ministry of Defence and other Government departments to develop the National Shipbuilding Strategy Refresh. Our focus on better understanding and exploiting the many opportunities that exist in the international maritime export markets – both naval and civil – is closely aligned with the strategy's emphasis on delivering a stronger national effort to expand sales of ships, equipment, design and project management services.

**ESD:** Most of our discussion to date has focused on the defence maritime sector? To what extent does the civil maritime sector feature in your plans?

**Goldsack:** Developing exports into the civil maritime sector is a fundamental part of our ambitions. The sea is the common factor that unites our efforts and we have to recognise that shipbuilding and many of the sub-systems that support it are agnostic as to whether they are serving a naval or mercantile purpose. Limiting ourselves to just the naval market would, in effect, be artificially restricting the business that we might be able to pursue. So, we are working in collaboration with colleagues focused on the commercial sector to, again, obtain a proper understanding of what market prospects are available and how they might play to our strengths. We already have powerful niche skills in segments such as yachts and leisure vessels but also see prospects in emerging sectors, such as offshore wind and maritime autonomous systems. To give another example, we envisage particular opportunities in leveraging the innovative design and technical skillset that are already embedded in the naval SME market across the broader maritime sector.

**ESD:** It would be amiss not to make reference to the CSG21 carrier strike group deployment. What opportunities does this provide for promoting your own message?

**Goldsack:** The CSG21 deployment is already having a powerful strategic impact, not least in attracting press comment across the world. It sends out a very strong message to every navy that we want to cooperate with that we have the ability to deploy a potent maritime capability across the planet and to work with our partners when we get there. That creates a relationship of trust that will be the bedrock of future long term collaboration. Moreover, the fact that we are able to showcase our technological strengths up close to each and every one of our allies along CSG21's route inevitably forms a sparking point for a series of conversations as to how we can share this capacity to mutual benefit.

**ESD:** Do you have any final observations?

**Goldsack:** Only to say that it is an exciting time to be promoting British maritime exports. We are fortunate to be in that rare space where the capabilities being provided by our own naval recapitalisation programme are closely aligned with the requirements of the global market. That presents huge opportunities both to drive forward our own maritime sector and also to proffer significant benefit to our friends around the world, not least in promoting shared values such as the green agenda. The prospects for developing enduring relationships capable of delivering lasting value are immense.

**The Interview was conducted by Conrad Waters, Co-Editor-in-Chief of our sister magazine "Maritime Security & Defence"**

Photo: Crown Copyright 2021



**The CSG21 carrier strike group is providing a valuable opportunity to display the United Kingdom's technological capabilities on the world stage.**



## CHARACTERISING LATVIA'S DEFENCE INDUSTRY

The defence and security industry faces similar challenges around the world: materials availability, international travel limitations and budget restraints. While these factors make us prioritise investment, companies that adapt to the new circumstances will have market superiority. Cooperation between armed forces and industry will help strengthen supply chains and secure economic recovery in this sector.

### Challenges

Latvia's fast-growing defence industry must attract more financial and human resources to invest more in innovation, and offer more products and services for its growing national security and armed force's needs, and to realise EU and NATO defence capabilities' plans. Successful cooperation with and support instruments from Ministry of Defence of the Republic of Latvia contributes in achieving more remarkable results. Despite COVID 19, continuous international exchanges of information and cross-sectoral cooperation is vital for strengthening

defence and dual-use industries supplying forces for asymmetric and hybrid warfare.

The successful cooperation developed with defence and security sectors strengthen long term civil protection and digital transformation. There are engineering skills gaps to bridge and an opportunities for active life-long learning in in the security and defence sectors. Industry will accomplish this by retraining and integrating retired personnel in companies. The pragmatic phase of technology-driven modernisation planning and implementation that we are entering now will allow the defence-industrial complex to be more resilient to meet future demands with secure supplies.

### Strengths

The defence industry is gifted with an industrial heritage, openness to emerging technologies and good work ethics. Considering the current industrial base, there are valuable competencies in electronical warfare, cybersecurity and deep learn-

ing, robotics, composite materials, space technologies. And mature producers like: SRC Brasa with PPE and tactical wear, ICT services provider DATI Group and unicorn to be Exonicus, UAV Factory's fixed wings UAVs and surveillance systems; Belss with remarkable system integration and radio communication expertise are all renowned, world-class companies.



By Mrs Elina Egle, Chairperson,  
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## BELSS: SUSTAINING ACHIEVEMENTS FOR MODERN MILITARY DEMANDS

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to develop uniquely sustainable solution for military customers.

### Local Contribution

Belss is involved in a Countermine ships modernisation project for Latvian Navy in cooperation with French company ECA Group. We are providing local contribution requirements, common practice in Latvia. As such, we are providing project management and attracting several local companies as subcontractors.

### Belss 2022

We are investing in our manufacturing facilities to enlarge our scope as a system

integrator. As we continue to grow, our growing range of partners ensures we can fulfil military customer needs. Belss is honoured to participate in the EDIDP co-financed Mine Risk Clearance for Europe project, which underscores our importance in future European defence capabilities.

# BELSS

By Mr Kaspars Ziediņš,  
Board Member, BELSS  
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Belss is a member of  
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# Domestic Military Assistance to Civilian Authorities

## Evolving Needs and Enduring Principles

**Manuela Tudosia**

Since the end of World War II, in democratic countries, military continued to fulfil the role conferred by constitutions based on the principles of civilian control and political neutrality. However, throughout the Cold War, their intervention on home soil was rare. The peaceful “wind of change” brought by the fall of the Iron Curtain distanced collective perceptions even further from the idea that military support would be needed at home. Instead, the conflict in Kosovo in the 1990s marked the start of more than two decades where our troops were needed abroad, for humanitarian interventions or to fight terrorism and stabilise regions whose unrest could also impact our domestic security.

### The Rationale of Domestic Military Assistance

Despite some variations in democratic legal frameworks concerning modalities of parliamentary oversight and determination of their scope of intervention, the core role of the armed forces remains to defend own territorial integrity and society. As a result, most of these legal frameworks allow for military intervention on home soil, at the request of civilian authorities.

Such interventions can be seen as part of an overall Resilience effort, meaning a “society’s ability to resist and recover from major shocks, such as a natural disaster, failure of critical infrastructure, or a hybrid or armed attack”. In NATO, this principle is anchored in the Article 3 of the founding treaty, and it is understood as a combination of civil pre-

Photo: Georgia Army National Guard



**A mobile testing team comprised of Georgia Army National Guard soldiers administers COVID-19 tests to staff of Central State Hospital in Milledgeville, 21 April 2020.**

paredness and military capacity. The Allies commit to maintain and strengthen their resilience, as such, contributing to reducing the vulnerability of the Alliance as a whole. The last decade has seen a multiplication of the situations where the military were called upon to support civilian authorities. The floods in Germany and Belgium in the summer of 2021 and the continuing COVID-19 pandemic are the most representative examples where military are mobilised for logistic support and specialised know-how. Flood clean-up and population evacuation, airlift for medical supplies and patient transportation, setting up of field hospitals or deployment of CBRN protection often require specialised equipment, and training, that are primarily available in the armed forces due to the nature of their tasks.

Unlike assistance in natural disasters, military interventions to support domestic fight against terrorism or help maintain public order are often more contested although also made at the request and under the control of civil authorities, including an obligation to follow instructions of the police. Because these interventions may imply the need for legitimate use of force, debates over the interpretation of the constitution

and of the legal frameworks – for example, the counterterrorism or the criminal laws – tend to be more heated and politicised. Operation VIGILANT GUARDIAN was launched by the Belgian Armed forces in January 2015 following the Charlie Hebdo terrorist attacks in Paris with the aim to support the Belgian Federal Police to monitor and secure sensitive sites. The March 2016 terrorist attacks at the Brussels Airport and the Brussels metro made this support even more necessary. The operation continues, with a reduced number of deployed military than initially and in the background of political discussions to bring the operation to an end.

Belgian Defence explains on its website that the participation of military in surveillance missions inside the country contributes directly to the security of the population and that, in the event of a high terrorist threat inside the country, the optimal security of the population and the integrity of the national territory may be threatened. This did not prevent debates over whether the role of the military is limited to external deployment, even if the constitution does not make an explicit distinction between external and internal deployment. In reality, the

### Author

**Manuela Tudosia** is government affairs expert in defence, and contributor to the NATO Industrial Advisory Group and NIAG Industry Interface Group. She is also founder of the Pole CM [Civil-Military Innovation Network], initiative that provides strategic advice to Small- and Medium-Sized Enterprises in defence.



deployed military had quite limited power to act, namely self-defence and a concrete, manifested terrorist attack. Unlike the police forces, they did not have the possibility to take preventive actions.

This type of deployment is not unique to Belgium. Operation SENTINELLE in France and Operation TEMPERER in the UK, both started in January 2015 and respectively May 2017 following terrorist attacks, have a similar task to support and complement the efforts of the homeland security forces. Likewise, both were met with a combination of support, reluctance and even criticism, depending on the stakeholders engaged in debate.

The US National Guard instead, can be seen as a unique structure in the perception of many European countries accustomed to a clear separation of military and homeland security roles. The Guard "is a unique element of the U.S. military that serves both community and country. [It] responds to domestic emergencies, overseas combat missions, counterdrug efforts, reconstruction missions and more. (...) Guard Soldiers' primary area of operation is their home state."

The complexity, unpredictability and surprising nature of situations where domestic military support is needed is illustrated by the United States Capitol attack of 2021 when National Guard units were eventually dispatched to secure the US Congress Building.

### Domestic Military Support and Use of Technologies

Public acceptance of domestic military support depends on both the object of the intervention and the perception of the technologies employed. Since much of the CBRN protection expertise lies within the military, the image of military deployments in the early days of the COVID-19 pandemic made little debate. The Salisbury nerve agent attacks in 2018 are also illustrative, this time for a suspected man-made attack. The UK Defence Joint CBRN Task Force was deployed to remove the Novichok nerve agent from the contaminated sites and the Defence Science and Technology Laboratory intervened for the analysis and the identification of the agent.

On the other hand, the technologies used - or simply just considered - in the framework of public order interventions sparkle as many debates as the interpretation of the constitution. Non-lethal capabilities are a particularly controversial area for the public, whether considered by the military or the law enforcement. For example, much ink has been spilled about the alleged question by the military police to the US National Guard regarding the availability of the Active Denial System asked in the context of the Washington's Lafayette Square protests against the killing George Floyd.

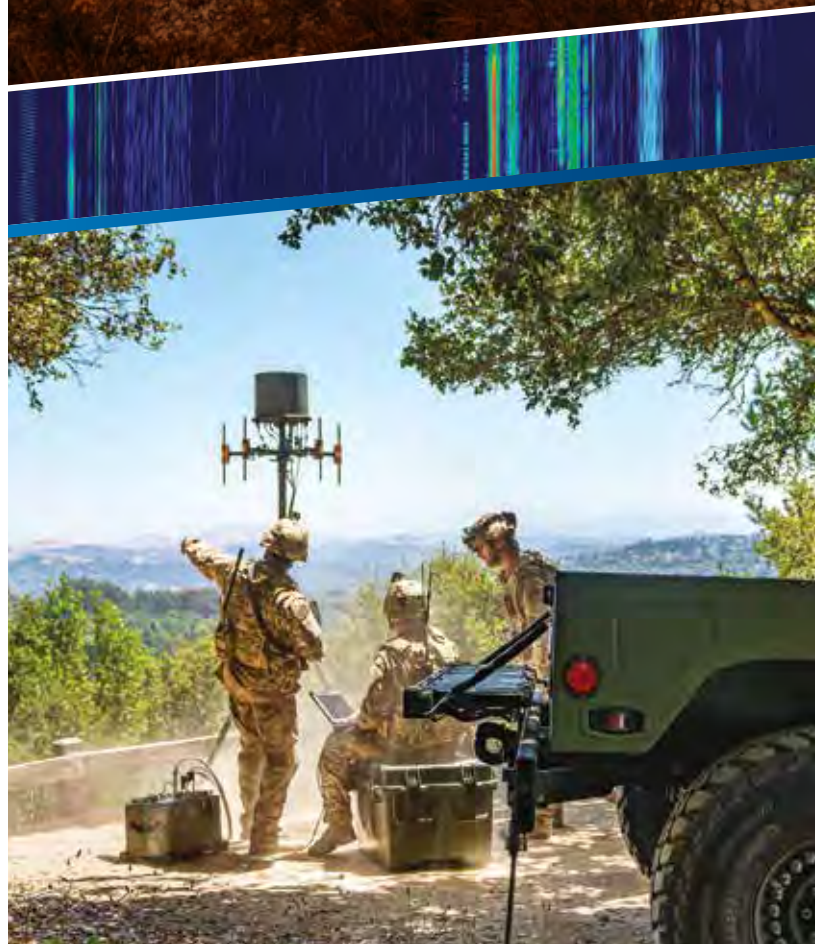
As malevolent as they can be perceived, the development of non-lethal technologies of any kind has the aim to significantly reduce probability of fatality or permanent injury or to disable equipment with minimal damage. Like CBRN protection and many other technologies, they are not specifically military or civilian technologies but can be considered as dual. Their use in international military conflict situations is subject to the Law of Armed Conflict and all the related international law. Their use in homeland security scenarios is or shall be regulated by specific Rules of Engagement and national legislation. In this respect, acquisition of such technologies by non-democratic regimes, where checks and balances are questionable, can be a reason for concern. This is the reason why export control regulations exist both at national level in all democratic countries as well as at multinational and international levels.



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## An Evolving and Ever Complex Security Context

To summarise, domestic military support to civilian authorities is an evolving need. However, it always remains based on the same core democratic principles of civilian control.

Public perceptions and acceptance of domestic military support are also evolutive. They depend on many factors, like collective memory, cultural aspects, or proper understanding of the role of technologies employed (or considered). Unfortunately, these perceptions can also be sometimes influenced by disinformation or misleading interpretation of facts, which in itself can be a vulnerability for societal resilience. Decision-makers from democratic legislative and executive branches must weigh in a diversity of factors before approving military support at home, often in situations where time is of the essence. To be able to take fast but balanced decisions, democratic institutions themselves must be resilient.

We live in a world of increasingly complex scenarios where boundaries between internal and external security are blurred, where tools used by adversaries



**German soldiers use a DACHS engineer tank to dredge a ford for disaster relief vehicles during the flood in the Ahr Valley, on 26 July 2021.**

are more subtle and sophisticated – like hybrid or cyber warfare, and where the rapid speed of technological innovation can be both an opportunity and a threat. These trends represent future challenges

that our civilian and military authorities will have to confront, and our legislators will have tackle in time so that legislative gray areas cannot be used by adversaries to their own advantage. ■

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# Terrorism and Counter-Terrorism in 2021 – Beyond the Pandemic Effect

**Andreea Stoian Karadeli**

The year 2020 marked a global shift in nearly all areas of our societies and the post-pandemic domino effect is still unfolding. The full-scale impact of the COVID-19 quarantine measures and lockdowns will only be visible in the long term. So far, some of its immediate effects have completely changed many of the pre-2020 paradigms, while influencing others, such as terrorist and extremist trends. After an assessment of the terrorist threat vs. COVID-19 in 2020, which appeared in the July issue, the second part of this article looks at the terrorist landscape in 2021 and the trends.

Terrorism has evolved further in a time of global crisis, highlighting visible trends that have deep roots, all of which are accentuated by the new, vulnerable security environment of 2021. While the pandemic has not been the central catalyst for any trend in the area of terrorism and counter-terrorism, it has definitely impacted directly or indirectly on many of its vital elements. While the 2020 focus has been intensively contoured around the battle against the SARS-COV-19 virus, 2021 serves to remind us that terrorism in its various forms still remains a threat to our societies.

## Extremism Fuelled by Conspiracy Theories

As we have seen in various times of crisis, conspiracy theories enter the void created by upheaval and continue to be stoked by grassroots movements and authority figures. Coronavirus conspiracy theories have had devastating public health consequences, increasing uncertainty, fear and panic among the population. Conspiracy theories that have warranted the attention of homeland security also include those pushed by QAnon supporters alleging “deep state”



Photo: pxhere

**A New York firefighter in the rubble after the 9/11 terrorist attack on New York City**

conspiracies and more, the 5G conspiracy theories alleging that technology is used to track people and/or spread COVID, and the white supremacist “Great Replacement” theory that claims there is an organised plot against whites and has been cited by mass shooters, including in Christchurch and El Paso. Most of the terrorist groups have used conspiracy theories related to the pandemic in their propaganda materials, irrespective of ideological background: this includes Salafi-jihadi, right- and left-wing groups. Each conspiracy theory used by these groups has proved to be based on the same elements, defined through separate ideological lenses.

## Homegrown Extremism

Right- and left-wing terrorism have increasingly become a transnational threat that “includes everything from racially

motivated violent extremists... all the way to anti-government, anti-authority violent extremists” (US Congress, 2020). For instance, the white supremacist movement has become a global trend through the believers in the “Great Replacement”: a prominent idea in the white supremacist ecosystem, which contends that the United States, Europe, and other “white” countries are being reverse-colonised, with Black, Hispanic, Arab, and other immigrants diluting the “white world”. Although the idea emerged in France, it has spread among white supremacists around the world. Salafi-jihadi extremists and white supremacists both try to appeal to grievances, hoping that potential recruits who might not otherwise join their movements could be pushed over the edge with targeted psychological propaganda.

## Author

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Photo: Pixabay

**Ground Zero is where the World Trade Center stood before the terrorist attack on the twin towers on 11 September 2001.**

Together with the continuous threat posed by Daesh, the last few years have seen a dramatic increase in the threat presented by both the far right and far left. As the data in the GTI highlights, there has been a 250 per cent increase in far-right terrorist incidents since 2014. In Western countries, far-right extremism now accounts for 46 per cent of attacks and 82 per cent of deaths from terrorist attacks. The US has witnessed an increased threat from homegrown terrorism not seen in a quarter-century, with right-wing extremist attacks and plots greatly eclipsing those from the far left and causing more deaths. Since 2015, right-wing extremists have been involved in 267 plots or attacks and 91 fatalities. At the same time, attacks and plots ascribed to far-left views accounted for 66 incidents leading to 19 deaths. In the coming years, we may witness more violence from domestic extremists, either by multiple members of a group or movement or lone attacks with blurred lines of ideological motivation.

Among the “three main terrorist personas”, the Salafi-jihadi groups have promoted themselves as a global brand, easy to reach and connect, unlike the far right and far left groups, who are still trying to understand and define their identities. The rise in far-right terrorism is part of a broader rise in political violence (including violent demonstrations and riots) in the West, emphasising an insight threat that has been present for a long time within our Western borders, but whose nature and identity is both hard to define and identify. As the number of terrorist attacks worldwide has decreased in recent years, worrying trends associated with the fragmentation of Daesh and the global swell of far-right and far-left terrorism and political violence suggest that, when it comes to terrorism, it is important

to maintain strategic-policy focus. While the political, social, and economic pressures may be great, concerted and ongoing efforts to address terrorism trends based on empirical data and local experience are nothing short of essential in 2021 and beyond if we are to continue this five-year downward trend in terrorism worldwide.

### Simple vs. Complex Attacks

In September 2020, the FBI Director Christopher Wray told the US Congress that the greatest threat to the homeland “is not one organisation, certainly not one ideology, but rather lone actors, largely self-radicalised online, who pursue soft targets using readily accessible weapons.” Most of the terrorist attacks witnessed in Europe in recent years have proved his words to be true. Still, as the pandemic unfolds and the opportunities arise, many have started to wonder how the next complex terrorist attack will take place. Bearing in mind the symbiosis of the “trinity of terrorism” that has only been seen with the propaganda so far, there is one slight possibility for those groups to share more than radicalisation tools. Although hard to imagine, the lines between ideologies become blurred when it comes to common practical interests and 2021 could bring complete shifts in strategy and practice of terrorist attacks. Among Salafi-jihadi groups, the complex coordinated attacks in Paris, Mumbai and Sri Lanka are recycled in propaganda and recruitment materials as the gold standard of attacks. Individual operations have been encouraged by both Daesh and al-Qaeda as they have acknowledged that their homegrown loyalists in the West and other target regions aren’t always the brightest bulbs and may be less likely to catch the attention of law enforcement in the planning stages by

working alone. Encouragement of lone operations can also lead to more opportunistic attacks and can give freedom to low-skilled terrorists to use simple weapons and tactics to the best of their abilities. But these groups are also aching for a fresh complex coordinated attack as an ideal recruitment and propaganda boost as they evolve and grasp at new opportunities.

In the case of Salafi-jihadi groups such as Daesh, any of the former terrorist fighters who have travelled from the conflict zone and managed to disappear have the potential to organise a complex attack due to their training and battleground experience gathered in Syria and Iraq.

### The Next Salafi-Jihadi Generation

Though Daesh lost its caliphate, it is already famous for its amazing capacity to evolve and expand even during the most challenging of times. The virtual caliphate – a chimera of the physical one – is continuously building the network of supporters and recruiters, ultimately posing a greater threat in the long term than the one defeated in Syria and Iraq. Through the online space, the groups recruit, inspire, and teach homegrown violent extremists anywhere in the world, while sending threatening messages to prove their resilience. Although many have rushed to declare victory against the groups, Daesh has proved once again that its ashes are its main strength. Its provinces are still active, particularly through attacks in West Africa and Afghanistan. More importantly, they have laid down a framework of borderless jihad and a blueprint for growing a terror movement both on the dark web and the open internet that is impossible to rein in. And while COVID-19 hasn’t left their own ranks untouched, the virus has had the group thinking more about bioweapons and unconventional attacks as we look ahead.

Similarly, the Taliban and their relation to both al-Qaeda and Daesh highlight a complex network of common interest and calculated strategies. Terrorists no longer live, communicate, or recruit in silos: a victory against a common enemy is viewed at its core a victory for all, and that is feeding the ever-growing and accessible ideological marketplace of terrorist ideas, methods and inspiration – in addition to the physical assistance the Taliban and their terror allies share. Jihadist groups have developed effective and sophisticated communication strategies via the creation of magazines and weeklies such as Dabiq / Dar al Islam / Rumiya / al Naba’ (ISIS) and Inspire / one



Ummah (Al Qaeda), but mainly via social media channels such as Facebook, Twitter, Telegram, Instagram, Rocketchat, Tam Tam and Riot. Jihadist groups' online strategy – the “cyber-jihad” – is perceived by terrorism experts as the perfect reflection of terrorists' core interests: their ability to communicate on logistical and operational issues as well as their survival capacity through the spreading of their radical propaganda and the recruitment of new adherents or sympathisers. Therefore, the propaganda strategies of those groups have a dual effect: they serve both as a tool for terrorist movements to enforce their belief system on potential recruits and as a means to signal alternative forms of legitimacy and distinguish themselves from rival movements. While Daesh-core has experienced a significant decline in capability and loss of territory, it is not defeated. One mistake could bring us back to the 2007 “Anbar Awakening” in Iraq. Back then, the international scene witnessed the ability of the Islamic State in Iraq (ISI), as it was called then, to rebuild itself and reach even greater heights. ISI's strategy is based on a staged approach—not dissimilar from the Maoist strategy of protracted warfare—and after their defeat in the “Anbar Awakening” they simply returned to a lower stage, went underground and re-grouped in the countryside. They expect to oscillate between stages before eventual victory. It is important to remember that it is this strategy that is arguably its primary export to global affiliates. If we repeat the same mistakes, the already built Daesh brand is more than capable of re-emerging and rising in strength once again.

### The Lost Soldiers of a Fake Caliphate

Ten years ago, the Syrian civil war represented the perfect storm to be manipulated by the terrorist groups that have threatened the region for a long while. Today, thousands of family members of Daesh fighters, mainly women and children, are kept in refugee camps and prisons in Syria and Iraq, with some serving their sentences in their home countries, and hundreds more militants have been hiding from justice around the world. The Arab Spring started with hope but turned into a fiasco, leaving behind a perfect “time-bomb” with two shells: the current generation of Salafi-jihadi that disappeared out of the war zone and the next generation of Salafi-jihadi that is now forming in the refugee camps and prisons in Syria and Iraq. Both shells of the “time-bomb” are equally dangerous and can serve the terrorist purpose in both the short and long term.



According to several official reports and open sources, the Security Service of Ukraine (SBU) stated that they had uncovered a sleeper cell of Daesh militants hiding in Kyiv, accusing them of conducting underground activities. Ukrainian Security Services also mentioned that the leader of this cell was a citizen of an Eastern European country who had participated in the Syrian war. In 2019, he arrived in Ukraine with fake documents and gathered a group of like-minded foreigners, with the goal of returning to Syria to participate in a new war on the side of Daesh. Ukraine long ago became a destination for Daesh militants fleeing the wars in Syria and Iraq. At the end of 2019, Caesar Tokhosashvili, a Georgian citizen, was arrested in Kyiv. He was one of the deputies of Daesh's so-called “Minister of War”, Umar Shishani, and a comrade of the leader of the Daesh secret police (“Amnia”) – a Chechen native, Akhmed Chatayev. Tokhosashvili faked his death in late 2017, fleeing first to Turkey before settling in a small town near Kyiv. His escape strategy proved so efficient that he had even set up a small business at the local market. Unfortunately, he is not the only one who managed to go underground and wait for the next mission. The number of Daesh members hiding underground around the world is hard to estimate. In the case of Ukraine, according to various sources, the country is currently playing unwilling host to anywhere from 50 to several hundred militants who fought for the Islamic State. Ukraine has also represented the

perfect destination for many Westerners who joined right or left-wing groups and travelled and fought in the Syrian war first. Just like the sleeping cell denounced by the Ukrainian Security Services a few months ago, hundreds of similar terrorist groups related to Daesh might have made their way out of the Syrian conflict. In the same way, dangerous foreign terrorist fighters with Western backgrounds have also left Syria, while believed to be deceased by the authorities, thereby making their way to an underground life.

An example of one such case is Thomas-Marcel Christen, also known by the name Abu Musab al-Almani. In 2015, a Daesh cell killed hundreds in Paris and Brussels, while the identity of their instructor, Thomas-Marcel Christen, was kept secret for a long time. A Swiss-German convert, originally from Aargau, Christen came from a separated family. He lived with his father at a campsite in France for several months in 1998, before his mother took him back to Switzerland and then moved with him to Frankfurt in 2006. Christen often visited Frankfurt's Abu Bakr mosque where he converted to Islam in 2009. This is the place where he is known to have met the radical Moroccan-German preacher Said Emrani, aka Abu Dujana, for the first time, whose sermons pushed him towards radicalisation. After moving to Bonn, Christen married a close relative of Abu Dujana, with whom he had a daughter. In March 2013, he travelled from Cologne to Paris and then to Istanbul, taking with him

Photo: UN / Marco Dormino



**MINUSMA peacekeepers investigating the site of a terrorist suicide bomb attack**

cellphones, laptops and €15,000. Christen - Abu Musab al-Almani - quickly rose within the Daesh ranks, reaching the rank of Head of the Amniyat Unit in Manbij in 2014. He made himself known for his commitment to the cause and for the language skills that helped him instruct and direct wider networks: German, English, French, Arabic and reportedly also some Russian. Unlike other foreign fighters who posed with guns and black Daesh flags, Christen was very strict in regard to footage of himself: he never posted pictures and would confiscate cellphones when he suspected that someone had taken a photo of him.

Christen reached even higher ranks and got to know Abu Mohammed al-Adnani, Daesh's official spokesperson, a veteran of the organisation since 2003 and one of its most senior leaders. He reportedly married a close relative of al-Adnani, ensuring personal ties to the core leadership of the group. Al-Adnani was also head of Daesh Amniyat and its external operations. While most Daesh attacks worldwide have been executed by supporters who might have been instructed via messengers, Daesh also trained attackers in Syria for much more sophisticated attacks. Christen soon became a key player within this branch and assumed the rank of Amir for his own special unit, Katiba Furqan. The unit was based in Raqqa and had between 50 and 100 members whom he trained for terror attacks abroad.

On 13 November 2015, a suicide bomber blew himself up outside the Stade de France stadium during a football match. Soon after, several other attacks took place in bars and cafés, killing people with military precision. The attackers were equipped with assault rifles which they used in single fire mode,

murdering their victims with great precision. More than three dozen people were killed in bars, restaurants and open streets. Further on, Daesh terrorists Foued Mohamed-Aggad, Ismail Omar Mostefai and Samy Ammour stormed the Bataclan hall where the American rock band Eagles of Death Metal were playing. The attackers murdered 89 people with assault rifles and explosive devices. The ringleader, Abdelhamid Abaaoud, managed to escape and was killed in a raid five days later. Salah Abdeslam, the only survivor of the terrorist cell, escaped to Belgium where he joined the rest of the Paris-Brussels Daesh terror network.

The attack represents the most significant Daesh external operation to date. The French Government declared a state of emergency, and thousands of soldiers were deployed throughout the country. While many names within the Daesh network were pointed out during the investigation, the name of the key member did not show up: Thomas-Marcel Christen. Authorities knew his Daesh name - Abu Musab al-Almani - but were unsure about the elusive person hiding behind it - who wasn't a German national, but a Swiss. The lack of pictures and videos of Christen made the work that much harder for the authorities. He also broke off all contact with family back in 2013.

Later, in January 2016, a video released by al-Hayat presented new footage of the Paris attackers. The footage shows the Paris attackers dressed in combat gear shooting and decapitating prisoners most likely somewhere in Syria. Among them were the Bataclan attackers. But there was also one short sequence which shows one of the Paris attackers during a live fire exercise, localised most probably at an abandoned military base in the vicinity of Raqqa/

Tabqa. The attacker was identified as Brahim Abdelslam, aka Abu Qaqa al-Baljiki, who later shot people in bars and restaurants and finally blew himself up in the Comptoir Voltaire café. During the combat exercise, an instructor can briefly be seen pushing Abdelslam during the shooting, to train him to keep focused on his targets even in a panicked crowd. The mysterious instructor is seen to be wearing combat gear and a balaclava, but he was also pixelated by Daesh media to make his identification even harder to ascertain. The pixelated trainer we can see in this short sequence was later identified as Thomas-Marcel Christen, the elusive instructor of the Paris attackers.

As authorities moved forward with the investigation, suicide bombers attacked Brussels airport and a metro station, killing 32. At least two members of the cell were trained in Syria beforehand. After the Brussels attack, Daesh al-Hayat media outlet released another video which includes the same sequence of Abdeslam during his training with Christen, but this time the Paris attacker can be heard speaking. The video goes on to show the training sequence with Christen again, but then also showing scenes of the Brussels attack and Brussels cell members Najim Laachraoui and Mohamed Belkaid who wear the same combat gear as the Paris attackers and were also instructed by Christen.

The deadly attacks in Paris and Brussels were also a further career boost for Thomas-Marcel Christen within the ranks of the Amniyat. He was promoted and became the overall Daesh ExOps commander for the whole European theatre, subordinate only to Abu Mohammed al-Adnani. Although extremely dangerous and well-trained, Christen's location is currently unknown to the authorities. And he is just one of the many fighters who managed to escape underground before the defeat of the fake caliphate.

## Conclusion

The COVID-19 pandemic has shifted much of our attention to various different areas of our societies but has not reduced any of the previous threats. Although indirectly impacted by some of the pandemic's side-effects, terrorism remains a pressing global issue that has developed dangerous trends, mostly visible in 2021: conspiracies, homegrown extremism, rise of far right and far left extremism, threat of complex terrorist attacks and the Salafi-jihadi return. ■



# Significant Shifts in the Geopolitics of the South Caucasus

**Gayane Novikova**

**A new status quo has emerged after the 2020 Nagorno-Karabakh war in the South Caucasus. Its main manifestations can now be defined.**

Involvement of the major global actors in the regional conflicts is diminishing, especially when viewed against the background of global security concerns related to health, poverty, migration, inequality, and cyber security. Although the current US administration has announced “a return of America on the global stage” and the EU leadership has stressed its readiness to contribute to peace in the South Caucasus, leverage to deal with hard security issues is lacking on both sides. Their involvement in regional affairs will be limited to assisting the implementation of “soft power” programmes. China is seeking to expand its economic might, mainly through its “Belt and Road Initiative,” a part of which includes the South Caucasus states. In the meantime, China faces several serious domestic problems and economic challenges all of which have slowed down its economic involvement in this region.

Regional security issues have increasingly become a source of concern and area of responsibility for the regional powers – Russia, Turkey, and Iran: their interaction is shaping the security environment. Hard security measures will remain a prerogative of Russia, Turkey, and – to a lesser extent – Iran.

These transformations should be taken into account in any further discussions on the security of the entire region and each of its constituent states: Armenia, Azerbaijan, and Georgia. In the next several years, the South Caucasus states will become fully involved in a direct and rigorous Russian-Turkish geopolitical rivalry.

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Photo: MoD Armenia

**In 2020, during the war between Armenia and Azerbaijan over the disputed territory of Nagorno Karabakh, this photo published by the Armenian MoD became an iconic image in the Armenian press. The soldier depicted died during the war.**

## Turkey's Breakthrough

The recent Nagorno-Karabakh war fulfilled Turkey's desire and intention to become a major regional power, to challenge Russia openly in political, economic, and military arenas, and even to try to minimise the latter's influence and positions in the South Caucasus. At the current stage of the Russian-Turkish competition, Armenia and Georgia have clear preferences. In Armenian political circles and the society at large, Turkey's unequivocal and multidimensional assistance to Azerbaijan – both in the course of the Nagorno-Karabakh war and after the ceasefire agreement – left no doubt that Ankara will continue its full-scale support of Baku.

A growing ambivalence has occurred as concerns the evaluation of Russia's role as Armenia's main strategic partner. At their core are Russia's inability (or unwillingness) a) to defend Armenia in accordance with the bilateral agreement of 2017 on joint Russian-Armenian military forces; b) to prevent both military incidents along the Armenian-Azerbaijani line of contact

and advance of Azerbaijani army units into Armenia's sovereign territory in two provinces; and

c) to oblige Azerbaijan to return all Armenian “prisoners of war and other detained persons” in accordance with Article 8 of the November 2020 trilateral ceasefire agreement.

Simultaneously, Russia has announced its readiness to assist Armenia and Azerbaijan with the accelerated delimitation and demarcation of the Armenian-Azerbaijani borders. Russian officials insist that negotiations on the status of Nagorni Karabakh should be resumed immediately after resolution of the border issues.

Georgia's approach to the two regional powers is quite firm. Russia actually opened a gate to the South Caucasus for Turkey. The recognition of Abkhazia and South Ossetia in 2008 made Russia de facto a party to these conflicts; it has solidified its military presence in these areas inside the internationally recognized territory of the Republic of Georgia. This Russian-Georgian enduring confrontation allowed Turkey gradually to become Georgia's most valu-

Photo: president.az



**Azerbaijani President Ilham Aliyev speaking to the military leadership of Azerbaijan on the Armed Forces Day**

able economic and military partner. The Turkish-Georgian strategic partnership is based first of all on the absence of political problems. Turkey has recognized Georgia's territorial integrity, and fully supports its aspiration for NATO membership.

Azerbaijan is a decisive actor in this new round of Russian-Turkish competition. The most significant leverage in Russia's Azerbaijani politics was the unresolved Nagorniy Karabakh conflict. In the course of the last several years, Azerbaijan did not hide its frustration with the Russian position both as a mediator and as Azerbaijan's strategic partner. With Azerbaijan's military victory over Armenia, Moscow lost the remains of its control over Baku especially if one takes into consideration that neither the Russia-led CSTO nor the Eurasian Union can be attractive for Azerbaijan.

Russia has been forced to consider Turkey's recent advance seriously. However, several immediate steps taken by the Turkish-Azerbaijani tandem allow to conclude that Russia's position and its role in the entire South Caucasus area are diminishing—despite even the deployment of its peacekeepers in Nagorniy Karabakh. The Armenian-Azerbaijani-Russian ceasefire agreement (9-10 November 2020) did not contain a single word regarding Turkey's projected activity in the area of the Nagorniy Karabakh conflict. Then a few days later, Turkey and Russia announced the establishment of the Joint Center for Monitoring the Ceasefire (JRTCM) in the Aghdam district of Azerbaijan. Its launch in January 2021 allows Azerbaijan to balance Russia's military presence in its territory. Even more, it

marked a reestablishment – after more than a century – of Turkey's military presence in the South Caucasus.

The future of Russian forces in this South Caucasus state is in question. According to Article 4 of the trilateral ceasefire agreement, "the duration of the stay of the peacekeeping contingent of the Russian Federation is five years, with automatic extension for the next five-year periods if none of the Parties declares six months before the expiration of the period of intention to terminate the application of this provision." With a high probability, the Azerbaijani leadership will terminate Russia's peacekeeping operation and will secure Turkey's military presence in the region.

The signing of the Shusha (Shushi) Declaration on Allied Relations by the presidents of Turkey and Azerbaijan, on 15 June 2021, should be viewed as a step in this direction. In accordance with this document, their strategic partnership in the military, diplomatic, and economic spheres has been raised to a qualitatively new level. The most important aspects of the Declaration concern the coordination of efforts and actions in all strategic and regional issues; mutual military assistance and the holding of regular joint meetings of the security councils of two states; the conduct of joint consultations and coordination of the actions of their armed forces in case of threats to their sovereignty, territorial integrity, and internationally recognized borders. A special emphasis was put on joint efforts aimed toward the "sustainable development of the Turkic world."

President Erdogan did not rule out his country's permanent military presence in

Azerbaijan: "This issue is not outside the provisions of the Shusha agreement." It should be noted that the discussions on the establishment of a Turkish military base in Azerbaijan are not new: Turkey already has a visible presence in Nakhichevan. After the withdrawal of Russian peacekeepers, the JRTCM can be transformed into a Turkish base.

Russia's reaction followed immediately: a spokesman of the Russian president stated that the deployment of NATO military facilities near Russia's borders is a reason for "special attention." It will try to prevent such a development; the question is whether it can succeed.

Another important aspect of the Turkish-Azerbaijani relationship appeared relatively recently: Azerbaijan has become a vocal supporter of Turkey's idea of a two-state solution for Cyprus. In July 2021, the Azerbaijani parliamentary delegation participated in the celebration of the 47th anniversary of the Turkish invasion of Cyprus. Supposedly as a quid pro quo for Turkey's support in the Karabakh war, Azerbaijan will soon recognize the Turkish Republic of Northern Cyprus.

## The Caucasian Chessboard

The newly-established security environment reveals advantages and disadvantages for the three regional powers and three regional states positioned on the geopolitical and security "chessboard" in the South Caucasus. Despite existing disagreements, Russia, Turkey, and Iran are enthusiastically discussing the possibilities of a broad, multilayered and multidimensional opening of the region in anticipation of huge economic benefits. Turkey will receive direct access to Azerbaijan and further to Central Asia; the far-reaching goal is a realization of Erdogan's pan-Turkic project;

Russia will establish a ground connection with the Middle East and the Persian Gulf states. Being in favour of multi-dimensional regional projects, it also has recognised that implementation of these projects will strengthen Turkey's position in the Caucasus and Central Asia. However, according to Article 9 of the truce agreement, "Control over transport communication will be carried out by the bodies of the Border Guard Service of the FSB of Russia."

Iran will be able to break through its international isolation and improve its economic situation. It is not by chance that the Iranian government, in parallel to Turkish President Erdogan's "Six-Country Regional Cooperation Platform" (11 De-





Photo: primeminister.am

**24 August 2021, Armenian Prime Minister Pashinyan introduced a new programme of the government for 2021-2026.**

cember 2020), suggested quite similar regional cooperation project in January 2021. Although Iran is the only regional power that has stable relations with all three South Caucasus states, its capacity for economic infusion cannot compete either with that of Turkey or Russia.

In general, Russia, Turkey, and Iran have expressed their readiness to work together on opening the transport routes and corridors across the region. All three are also interested in minimisation of the role and activity of external powers, first of all the US.

Azerbaijan will unambiguously benefit from all these projects. As for now, Georgia and Armenia have rejected these initiatives for different reasons. Georgia's concerns are mainly related to Russia's participation in these projects owing to its control

over Abkhazia and South Ossetia, and its increasing military presence in the region. Furthermore, Georgia has introduced itself as the only pro-Western and pro-Euro-Atlantic state in the region. Hence, concerns exist among Georgian political and analytical circles that the proposed broad regional cooperation projects will reduce even more the interest of Euro-Atlantic structures toward the South Caucasus. Finally, of concern, however silent, is that the opening of communications through the southern section of the region implies the possibility that Georgia will lose its current unique status as the only transit route across the region.

Armenia is the most vulnerable among the regional states. The major issue for this nation is a preservation of its sovereignty, territorial integrity, and security

for its population. The Azerbaijani leadership continuously makes territorial claims and provokes tensions along the line of contact. On 12 May 2021, Azerbaijani military units penetrated into Armenia's sovereign territory and remain there up until now, continuously threatening the population of the villages and interrupting their normal life. On 28 July, deadly clashes were provoked by Azerbaijan in the Gegharkunik province of Armenia. Turkey and Azerbaijan insist on the opening of a corridor through Syunik province of Armenia (in their terminology, Zangezur corridor) to connect the main part of Azerbaijan with Nakhichevan. The Armenian side resists this idea by appealing to Article 9 of the trilateral ceasefire agreement, where no "Zangezur corridor" is mentioned: "All economic and transport links in the region are unblocked. The Republic of Armenia provides transport links between the western regions of the Republic of Azerbaijan and the Nakhichevan Autonomous Republic ... By agreement of the Parties, the construction of new transport communications linking the Nakhichevan Autonomous Republic with the western regions of Azerbaijan will be provided."

The situation in the area of Armenian-Azerbaijani confrontation is crucial for all further developments in the broad South Caucasus region. Among others, four questions assume a special urgency and remain to be answered: 1) For how long can Armenia withstand pressure from Azerbaijan and Turkey? 2) What price will be paid by Armenia for full-scale inclusion into the regional cooperation projects? 3) Will the de-blockade bring a long-lasting peace to the region, or 4) Will it further endanger the sovereignty of Armenia and interrupt its transformation to democracy? ■



Photo: Kremlin

**Azerbaijan is a decisive actor in a new round of Russian-Turkish competition. Depicted is a meeting between Russian President Vladimir Putin and Turkish President Recep Tayyip Erdogan in January 2020.**

# Russian Helicopters Made in India

## Indian-Russian helicopter deal stuck over local content

**Suman Sharma**

The Indian-Russian deal for 200 Russian Ka-226T helicopters to replace the ageing CHETAK and CHEETAH fleet of the Indian Army and the Indian Air Force (IAF) is stuck over percentage of local content and changed requirements, resulting in a delay to the US\$1Bn inter-

tec State Corporation, says that “The Joint Venture (JV) was established in May 2017 for the Ministries of Defence of both countries and it’s only for the production of the Ka-226T”, adding that the Russian side remains ready for commercial negotiations.

The deal specifies that 60 out of the 200 helicopters will be bought on a flyaway basis, while the remaining 140 will be assembled in India by the state-owned aircraft manufacturing public sector unit HAL (Hindustan Aeronautical Ltd.) according to the JV between HAL and IRHL (India Russia Helicopters Limited).

The first helicopter delivery was foreseen to take place within 36 months from the signing of the contract, which was scheduled to be completed in eight years. The first helicopter was expected to be ready by the end of 2020.

The twin-engine Light Utility Helicopter Ka-226T, built by the Kumertau Aviation Enterprise, Russian Helicopters, under Rostec State Corporation, at the Ulan Ude facility of Russian Helicopters, replaces the Indian military’s ‘70s vintage CHEETAH and CHETAK aircraft used for surveillance and troop supply for forward bases, which will be ending their total technical life from 2023 onwards.

According to the Indian side, the final contract is currently stuck as the Russian proposal of 62 per cent indigenous content in the assembled helicopters falls short of the tender requirement of 70 per cent. Meanwhile, the Russian side maintains that they submitted the proposal



Photo: HAL

**An Indian LUH test helicopter conducts high-altitude trials in the Himalayas.**

governmental deal which was signed in May 2015. “The Indian MoD changed the tactical requirements two years ago and the whole thing had to be redone and restarted. Percentage of local content, under ‘Make in India’ has yet to be decided. There are discussions about that,” said Victor N. Klavov, Rostec’s Director for International Cooperation and Regional Policy, in an exclusive interaction at the recently concluded MAKS-2021 international air show in Moscow.

Andrey Boginsky, Director General of Russian Helicopters which is part of Ros-

Photo: IAF



**An IAF CHEETAH helicopter carrying out a winching operation to rescue stranded people following the Chennai Flood in 2015.**

### Author

**Suman Sharma** is a Delhi-based journalist covering foreign policy and defence. Previously, she was an instructor at the Indian Military Academy.



for localisation of content to the Indian MoD and are ready for negotiations.

In order to meet localisation requirements, Russian Helicopters signed several MoUs with five private Indian manufacturers for supply of parts for rotor blades, fuselages, landing gear and radio equipment for the Ka-226T in February this year.

A roadmap was signed between both sides at Defexpo 2020, which laid down timelines for transferring design documentation, entering into contracts with suppliers, setting up production facilities, delivering machine kits and technological equipment, training Indian personnel and other key stages of the project to indigenise production.

The Ka-226T is a light, multi-role helicopter utilised for search and rescue, reconnaissance, surveillance and for transportation of troops and cargo. The Indian version specifically requires the ability to operate at high altitude mountainous terrain. The Ka-226T boasts a modular design and can be delivered in a variety of configurations. Seven passengers can be comfortably seated in the passenger model, while the transport model can carry 1,050 kg internally or 1,100 kg on an external sling. The Ka-226T has been tested at its optimal payload capacity at the world's highest battlefield – the Siachen Glacier – where it landed successfully at high altitude helipads.

HAL's Chairman, R Madhavan has said that the 70 per cent indigenous content in the Ka-226T is not the same as the LCA (Light Combat Aircraft). The 70 per cent relates to the Russian content. The French-made Safran engine and avionics from other countries are also not accounted for in this figure. Madhavan further explained that 70 per cent is taken from the balance that India is looking at. If the entire helicopter is taken into account, then the Indian domestic content would amount to approximately 27-33 per cent, with the transfer of technology.

According to the Russian proposal, the indigenisation content plan was to be managed in four phases, beginning with the first 3.3 per cent indigenisation for 35 helicopters, increasing to the second lot with 15 per cent for the next 25 helicopters, followed by 35 per cent in the third phase of the next 30 helicopters, and finally 62.4 per cent Indian content in the last phase for 50 helicopters. Powered by the Safran engine, 74 per cent of the overall content in Ka-226T is Russian, while 26 per cent is European.

Given the urgency to replace the vintage choppers and also due to the increasing threats from China and Pakistan at the borders, the Indian Armed Forces in their desperation have requested that the Government fast-track this particular procurement, adding that a certain minimum number should be bought straightaway.

Indian Navy helicopter pilot RAdm (Retd) Sanjay Vadgaonkar says, "Helicopters that are presently being used by the Indian Armed Forces at high altitudes have more than lived their life and the accident rate has gone up. It's imperative that these present helicopters are replaced for operational reasons and for the safety of the crews. The Government should incentivise the deal for the industry to participate in it."

## HAL's Light Utility Helicopter

HAL's own LUH (Light Utility Helicopter), given the go-ahead for development in 2008 by the Indian Government as a replacement for the CHETAK and CHEETAH fleet seems to be

## Masthead

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Cover: The UK's Main Battle Tank, CHALLENGER 2, will be upgraded to CHALLENGER 3 under the latest UK MoD plans. Photo: UK MoD, Crown Copyright

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Photo: Allover / CC3.0

**A Ka-226T helicopter at the 2009 MAKS Air Show near Moscow**

competing for the same space as the Ka-226T. The single engine, new generation three-tonne LUH undertook its first flight in 2016 and its Army variant was given its initial operational clearance in February 2021. The Indian Army is expected to receive the first batch of six LUHs by December 2022. Powered by a single Safran turbo shaft engine, the ARDIDEN 1U, the LUH is equipped with a Smart Cockpit Display System (Glass Cockpit), state-of-the-art HUMS (Health & Usage Monitoring System) and is designed for various utility and armed roles. It has successfully completed its high altitude hot and cold missions in the Himalayas, with adequate power margins. The LUH has un-

dergone rigorous trials including envelope expansion, performance and flying technicalities at the high altitudes of Leh. HAL's production of the Ka-226T clashes with its home grown LUH as both types are vying for the same space in rotary-wing platform usage by the Indian Armed Forces. It is possible that both helicopters can progress at the same pace since the new production facility at Tumkur, in the southern state of Karnataka, would cater to the enhanced requirements of helicopter production. Anticipating this conflict of interest, one can expect the possibility of a penalty clause inserted in the final agreement for the delay caused.

Russian Helicopters has also shown keen interest in holding talks with the Indian Navy for the supply of the 111 Naval Utility Helicopters on the grounds that both orders combined would add more value in enhancing capabilities.

## The New Ka-226T CLIMBER

Russian Helicopters unveiled the latest variant in the Ka-226 family – the Ka-226T CLIMBER helicopter. The CLIMBER is a civilian helicopter, and as the name suggests CLIMBER is ideal for flying in mountainous regions. Its coaxial rotors allow for easy control even at the highest altitudes with rarefied air. With its ability to fly at more than 6,000 metres, the CLIMBER boasts high resistance to strong side winds, as well as easy take-off and landing at high-altitude sites. The CLIMBER also performs well in flights over water. With low vibration levels, overall the CLIMBER is a light helicopter and easy to control.

The CLIMBER's fuselage is made using modern light materials, the flight controls and power systems are also highly modern, and a shockproof crash-resistant fuel system has been installed in line with the highest safety standards. The model also features enlarged fuel tanks and centralised refuelling. Where necessary, it can be equipped with oxygen systems, as well as air.

Serial production of the Ka-226T CLIMBER is planned to start in 2022 at the Ulan-Ude Aviation Plant in close cooperation with the Kumertau Aviation Production Enterprise. Moscow also sees India as a potential customer for the CLIMBER.

## ANSAT

"We are also working on the Indian market for our ANSAT helicopters", Boginsky says. The multi-purpose civilian helicopter – ANSAT - with the potential for transformation according to customer needs, is another product Moscow hopes to find a market in India for, having applied for aviation certification for the same.

The luxury version of ANSAT has the largest cabin in its class, called the VIP cabin. The helicopter has a light protection system with touch control, a technology used for the first time for a helicopter's VIP cabin. The ANSAT has been showcased with its comfortable cabin in the Aurus car brand style. Recognised as Russia's signature, Aurus is a premium brand used in both cars and aircraft of the same style. ■



Photo: Anna Tsveteva / CC2.0

**An ANSAT helicopter at the HeliRussia trade show**



# Attempting To Avoid Complications - Europe's Search for a Sustainable Security Strategy

**David Saw**

Prior to 1990, it used to be so simple for Europe in terms of security strategy. Sure, you were dancing on the edge of a volcano, but fundamentally, the situation was a simple choice. In the end, it was us versus them, and there were no shades of grey.

That was the thing about the Cold War. On one side, there was western Europe and NATO, supported by the US, and on the other you had eastern Europe, the Warsaw Pact and the Soviet Union. The threat was clear and responding to the threat was an obvious choice for European democracies. A security architecture was in place and it worked. By contrast, post-1990 security planning in Europe has been far more complicated and has remained that way for more than 30 years.

The two decisive moments for re-shaping the post-Cold War European security environment were German reunification in October 1990 and the end of the Soviet Union in December 1991. Both of these events would see maps redrawn for the first time since 1945. At the time, it seemed that the consequences of all of this would be absolutely benign. Yet, as we shall see, matters turned out differently than anticipated.

Providing a philosophical foundation for the new post-Cold war world was a 1992 book by the American political scientist Francis Fukuyama entitled "The End of History and the Last Man." The book was very influential. Its message was that the end of the Cold War and the collapse of the Soviet system and that of its sustaining ideology had brought to an end the ideological struggles that had defined the world for much of the twentieth century. Western liberal democracy had prevailed; it had become the ending point of human ideological evolution and, inevitably, Western liberal democracy would emerge as the universal form of human government. This was a time when the first President Bush could talk about a 'New World Order.'

Tantalising possibilities emerged to remake the world in the image of western liberal democracies. In a world free of strategic threats, there was little reason to spend large sums of money to sustain western



Photo: French Army

***A French Army LECLERC tank conducts a live firing during the LYNX 10 Mission Forward Presence by France and NATO partners in Estonia. The question of developing a true European defence identity separate from NATO, and what it should be, has yet to be resolved.***

militaries at the size they were during the Cold War. The era of the 'peace dividend' emerged. Consequently, military spending declined dramatically and the money saved was allocated to more politically advantageous purposes.

Unfortunately, as many in the West would discover, hailing the victory of western liberal democracy as the dominant global political and social ideology was fundamentally the view of western liberal democrats. They forgot to consider the fact that other cultures, other ideologies and other belief systems existed, and that these did not acknowledge the superiority of western democracy and in many cases considered it as an anathema. The historical current of the competition between two superpowers – the Soviet Union and the US – and competition between two ideologies – liberal democracy and Communism – that

defined the global agenda from 1945 onwards had, as Fukuyama had written, come to an end. The complexity of the post-Cold War world from 1990 onwards conclusively proved that history had not ended. As time went on, western strategic planners would crave the certainties of the Cold War world.

## Politics and Economics

Politics and economic strength are key factors in contributing to the strategic possibilities open to a country or group of countries. A healthy political system and a healthy economy are key contributors to social cohesion and national integrity. Clearly, Europe has experienced dramatic political and economic change in the post-Cold War era and there is no doubt that this will continue into the near future. Inevitably, this will affect Europe's future strategic

Photo: Bundeswehr/Marco Dorow



**A PANZERHAUBITZE 2000 of the German Army Artillerielehrbataillon 325 taking part in Exercise WHITE SPARROW in Munster during May 2021. On paper, European defence capabilities are impressive but the reality is somewhat different and more defence investment is needed.**

options and therefore, our starting point for this analysis will be to look at Europe's economic circumstances, followed by political trends.

Gross Domestic Product (GDP) is seen an effective measure of economic health. For this reason, we will start our analysis with a look at key European GDP figures from 1990 to 2020, using IMF and World Bank Data. But first a caveat: If one was to add together the GDP figures of all 27 current EU member nations and treat it as a single entity, you would have a de facto global economic superpower. However, although the EU might be a single-market, it is not a single

integrated economy and therefore, we will look at country-by-country GDP data.

In 1990, the top eight world economies in terms of GDP (by order of size) were: US, Japan, Germany, France, Italy, UK, Canada and Spain – that is, seven members of NATO and five EU members. By 2000, we start to see evidence of change; the rankings were: US, Japan, Germany, UK, France, China, Italy and Canada. The arrival of China as an economic world power is the significant change here. On the other hand, comfort could be gained from the fact that the top eight included six NATO and four EU members.

China's rise to economic prominence was seen as evidence of a future shift in the world economy. In 2001, the US financial institution Goldman Sachs published a research report where they coined the terms BRIC for Brazil, India, Russia and China, the report forecast that these four nations would dominate the world economy by 2050. In 2010, BRIC became BRICS as South Africa joined what had become an informal grouping of five nations. According to the Indian Ministry of Foreign Affairs, when discussing the BRICS Summit 2021, the BRICS nations have 41% of world population, 29.3% of world total land surface, 24% of global GDP and 16% of world trade.

Superficially, the BRICS thesis was very impressive and it certainly had negative economic implications for Europe, yet thus far, the BRICS thesis seems to have been overstated. Certainly, China has lived up to expectations and increasingly so has India, but as a whole BRICS has not delivered. Indeed, Goldman Sachs closed their BRICS investment fund in 2015. As regards Brazil and South Africa, you would have to be an optimist to make major investments there at this point.

Returning to our GDP listing, in 2010 the ranking situation was as follows: US, China, Japan, Germany, France, UK, Brazil and Italy. Four EU members and five NATO members in the top eight, the notable development being the rise of China to be the second largest economy in the world and Brazil surfacing as a top eight economy. In 2015, the rankings were: US, China, Japan, Germany, UK, France, India and Italy. Here the key change was the arrival of India as a top eight economy. This brings us to the 2020 figures, with the rankings as follows: US, China, Japan, Germany, UK, India, France and Italy. For 2020, it is the same eight countries as 2015, although the positions had changed. The other difference is that at the end of 2020 the UK officially left the EU.

Looking at these rankings for the global top eight economies, it would appear that Europe is still in a very good position, as are liberal democracies in general. Obviously, the most significant change is the rise of China and that has become not only an economic challenge to Europe, but also a strategic one. More recently, the Indian economy has embarked on an upward trajectory, a welcome development in both economic and strategic terms. India remains a strategic competitor to China.

The problem is that economic rankings based on GDP only tell part of the story. Bear in mind, they tell us nothing about the impact of COVID on national econo-

Photo: Crown Copyright 2021



**The aircraft carrier HMS QUEEN ELIZABETH, the primary element of the UK Carrier Strike Group, heads out of Portsmouth in May 2021 on a seven-month deployment to Japan and back. Increasing the European presence in the Asia-Pacific region offers both risks and opportunities, but it represents another commitment for overstretched European militaries.**





Photo: French Army

**A sniper team of 27e Bataillon de Chasseurs Alpins with the PGM HÉCATE II 12.7x99mm rifle, taking part in Exercise JABAL 2, a joint exercise with the Jordanian Army. Security commitments in the Middle East continue to be an important issue for Europe. In parallel, there are increasing threats developing in Africa that will need to be addressed.**

mies. One data set that provides a real insight into the health of an economy is the unemployment rate. The following are figures from May this year in selected European countries: France 7.5%, Greece 15.4%, Italy 10.5%, Spain 15.3% and Sweden 9.8%. The unemployment rate across the 27 EU nations averages out at 7.9%. Bearing in mind the ongoing economic impact of COVID, the fact that most European nations are running very high deficits, added to which inflation is becoming a factor and oil prices are rising, it is hardly an environment for a surge in employment. A stalling economy has obvious political implications and comes at a time when European politics is becoming more unstable.

One extremely concerning political development in Europe is the growing gap between the political elites and an increasing number of voters. Phrases such as “democratic deficit” are used to describe European politics and elite opinion warns of the dangers of populism and populist political parties in Europe. What is clear is that in many cases voters are becoming estranged from politics. Indications of this are declining election turnouts and membership decline in European political parties. Rather than tackle these crises, politicians turn towards supranational organisations such as the EU who can impose the rules and regulations that they require, without recourse to a democratic mandate from national voters. This seems like a recipe for efficiency and stability for those making the rules. Unfortunately it makes the “democratic deficit” a reality, delegitimises institutions and will eventually create instability. Political instability and poor economic performance are not pleasant companions.

## Threats - Real and Imagined

Looking at Europe today, threat definitions depend on which country you happen to be in at the time. This in itself is a grave problem. You can hardly have a unified approach to a threat, if some of your partner nations do not perceive it as a threat. Then there is national self-interest. It was in Germany's national interest to see the Nord Stream 2 natural gas pipeline go ahead as it would supply Russian natural gas to Germany and beyond into western Europe. On the other hand, completion of Nord Stream 2 is most definitely not in the interests of Poland. What is clear is that energy independence is more and more important for Europe, especially as pressure mounts to deal with the climate crisis and for a ‘Zero Carbon’ future

for Europe. The crux of the matter is how you can meet Europe's energy needs and go for ‘Zero Carbon’ at the same time? That will require some hard choices and whatever choices are made, it will be expensive. European governments are pushing for a future where electric vehicles (EV) will replace the internal combustion engine. This can be achieved, the only drawback being charging all of these EVs. Existing power grids will not have the capacity to support charging these EVs. Who will pay for the increased grid capacity to meet this increased demand? Politicians in Europe can posture on a future free of carbon but eventually, they will have to answer the question of where power is going to come from and how much it will cost. Finding an acceptable solution is essential as Europe could find itself in an energy crisis of its own making.

The Middle East continues to be an area of strategic concern for Europe, with operations continuing against the Islamic State of Iraq and the Levant (ISIL) in both Iraq and Syria. New dangers are emerging in this region though. Lebanon is a case in point as it hovers on the edge of becoming a failed state. Iran's proxy Hezbollah is at the centre of this crisis and no solution is in sight. Should everything fall apart, a refugee crisis is in the offing with Europe as the prime destination. Europe does not need more chaos in the Middle East.

Terrorism continues to be a major security concern in Europe. The danger continues to be that the perpetrators of terrorism will be European nationals radicalised in Europe. The Islamist strain of terrorism is not going to go away and the potential for political violence evolving into terrorism from left or



Photo: Nord Stream 2 / Igor Kuznetsov

**Pictured in September 2020, the Russian landfall of the NORD STREAM 2 pipeline, with pipeline work complete and other equipment being commissioned.**

right cannot be ruled out, especially if social cohesion declines further in Europe.

The question of Iran remains vexing for Europe. It is impossible to deny that Iran is a source of instability in the Middle East and beyond. It is also impossible to deny that Iran intends to have nuclear weapons. At the same time, there are those in Europe who delude themselves that Iran can be persuaded to moderate its behaviour and at the same time consider Iran to be a tremendous business opportunity if only normal relations could be resumed. The question of Iran is an excellent example of Europe's disjointed strategic calculus.

Turning to Africa, Europe is already enmeshed in trying to improve the security situation. The problem is that threats are growing faster than countermeasures. You have the Civil War in Libya and the ongoing conflicts in the Sahel spreading into neighbouring states. Islamist groupings are now operating as far south as Mozambique and the recent rioting in South Africa is hardly a sign of stability. The impact of COVID on Africa, both socially and economically has yet to be felt. Undoubtedly, the impact will be negative. More conflict, more failed states and further growth of the refugee crisis ex-Africa into the Mediterranean appears to be in prospect here.

South America must also be considered as an area of strategic concern for Europe. Not that long ago there was tremendous optimism regarding economic and social development in South America but post-COVID the picture is very bleak. There will be a battle for influence in this area. China is already in the game and Europe must be as well. Instability in South America impacts on Europe; weakened states will only embolden drug cartels leading to a tidal wave of narcotics into Europe. Incidentally, the growing power of the Taliban in Afghanistan is a concern, one major issue being that they fund their operations through opium poppy cultivation. According to a UN report on Afghanistan, the area under opium poppy cultivation to May 2021 had increased 37% on the year before.

The Russian annexation of the Crimea and Russia's military support of separatist forces in eastern Ukraine in 2014 suddenly put Russia at the top of the European threat calculus. Yet, if Russia was an existential security threat why would Germany make its energy independence vulnerable to Russia via Nord Stream 2? Russian foreign and strategic policy is one of opportunism; they see a weakness in one of their strategic competitors and they rush to exploit. Russia has its weaknesses as well though; its economy is in poor shape and popular discontent is growing. One welcome devel-



Photo: EDF

**Construction work underway at the Hinkley Point C nuclear reactor in the UK. This will be the first reactor built in the UK for more than 20 years and is due to come online in 2026. According to operator EDF, Hinkley Point C will provide 3,260 MW of power and will remain operational for 60 years. Europe will have to make some hard choices regarding energy as it heads for a post-carbon future.**

opment for Moscow will be the rise in the price of oil. Ideally, if the oil price were to go above US\$100 a barrel and stay there that would boost government revenues significantly. Money can buy a lot of political support and quell domestic dissent.

## China's Strength

This brings us to China. As previously noted, China has become the second largest economy in the world and by some analytical measures has become the leading world economy surpassing the US. It is only recently that China has been seen as a security threat. Previously, China was seen as a critical economic opportunity. In an economic context, China cannot be ignored. It is now a dominant force in world trade and extremely important for European exports. For example, China is the third largest export market for Germany.

China's economic strength has made it a global power, but the current international system devised and managed by liberal democracies constrains China's ambitions both politically and economically. As a result, China seeks to change the international system to its advantage and to challenge the US and the other liberal democracies. Its confidence that it can successfully mount this challenge is demonstrated by its ability to ignore the West on issues such as human rights and ongoing questions related to COVID with no fear of sanction. As

it stands, China believes that Europe needs China more than China needs Europe.

In parallel to China's economic development, it has also embarked on a massive and continuous programme of military modernisation and capability growth. Even the US admits that in numerical terms China has the largest navy in the world. It is not just about numbers though. They also admit that China has virtually closed the qualitative gap with the US Navy. They now refer to the Chinese Navy as "transitioning to a global multi-mission force." Chinese ground and air forces are also increasing their capabilities, as are China's strategic nuclear forces. Because China combines economic and increasingly military power on a global scale, it must inevitably be considered as a major strategic competitor to Europe.

At this point, Europe cannot be said to have a sustainable security strategy in global terms. There has been and currently are discussions on developing such a strategy. For the moment though, security strategy is a national-level concern, with an evolution towards security arrangements between limited groupings of European nations. Security in Europe devolves to those European nations that have the ability and the will to deploy military force where necessary. In many respects, that is a satisfactory solution. An alternative where 27 EU nations and the British have to agree on a course of action and rapidly make it a reality seems unlikely to produce results. ■



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# Driving Interoperability in Europe – FINABEL

**Tim Guest**

For Europe's armies, whether NATO Alliance members, or not, being able to work together effectively on and off the battlefield will be crucial in the months and years ahead. Interoperability between the armies of disparate, allied European nations, however, is not a given. For EU member states, that's where FINABEL comes in.

With the European theatre at its most precarious since the Cold War, allied western nations in Europe, including members of the EU, need a coordinated approach to the interoperability of their armed forces, particularly in the face of an increasingly belligerent Russia and its ever-stronger military ties with China, which must be seen as an equally, or substantially greater, danger to the future of the free world. To foster and drive such a coordinated approach to European army interoperability is the Brussels-based, FINABEL European Army Interoperability Centre, which promotes cooperation and interoperability between the national armies of EU member states. This article looks at the work of FINABEL, its study on interoperability and military mobility to ensure the armies of the EU, together with partner and observer nations such as non-EU members of NATO, can operate as effectively together as possible against any aggressor, should the need arise.

## Interoperability and FINABEL Defined

As the largest NATO member, it is worth noting how the HQ of the US Department of the Army defines interoperability in its April 2020 Regulation 34-1, entitled, unsurprisingly, 'Interoperability', with a definition unlikely to be challenged by allied stakeholders: 'Interoperability is the ability to act together coherently, effectively, and efficiently to achieve tactical, operational, and strategic objectives. In-



**FINABEL's 24 member states**

teroperability activities are any initiative, forum, agreement, or operation that improves the Army's ability to operate effectively and efficiently as a component of the Joint Force, within an inter-organisational environment, and as a member or leader of an alliance or coalition across the range of military operations.'

For FINABEL, which sees itself as com-

plementary to other military structures within the EU and to NATO, getting relevant stakeholders in Europe to understand and co-operate on issues of interoperability and collaborative defence, is pretty much its *raison d'être*; forging a common European understanding of all the defence issues affecting its 24 members - membership is open to all EU

Photo: NATO



**FINABEL's work on mobility interoperability highlights allied challenges faced transporting future-generation military equipment, often with physical dimensions greater than previous generations, across Europe. Pictured are Polish soldiers securing the straps on a BMP-1 infantry fighting vehicle at Mockava, Lithuania during Exercise Brilliant Jump 20.**

## Author

**Tim Guest** is a freelance journalist, UK Correspondent for ESD and former officer in the UK Royal Artillery.



states – is at the heart of its mission. The organisation promotes and facilitates ‘the interoperability of land forces across the full spectrum of military operations’, which it does through harmonising ‘concepts, doctrines and procedures in the joint military environment’. But to be able to do that it listens to feedback from its members through working groups and produces studies, recommendations, guidelines and research for defence decision-makers in response; it brings together the military commanders of



Photo: NATO

***FINABEL’s work on interoperability is an immense task. Some former Warsaw Pact nations now within NATO still operate Soviet-era equipment, and Baltic railways still operate Russian-gauge tracks, requiring the transfer of equipment from one size rail car to another before any onward/eastward journey. Pictured are Polish Army BMP-1 infantry fighting vehicles transferred by rail cars at the Lithuanian rail yard of Mockava during Exercise Brilliant Jump 20.***

its members in annual meetings designed to knowledge-share on all defence matters including land-force development. Indeed, the organisation is actually controlled by the chiefs of staff of its member states’ armies, though it does have a relatively small permanent secretariat and is, today, seen as an informal international de facto association, as its origin doesn’t stem from any formal intergovernmental agreement.

### **Studies and Events Driving Discussion**

FINABEL has addressed various interoperability themes in recent events and reports. One such event is last year’s conference in partnership with the Egmont institute on the Capacités Motorisée (CaMo) Project – entitled: The Ultimate Form of Interoperability, to highlight CaMo as an outstanding example of interoperability between Belgium and France. CaMo will allow Belgian land forces, newly-equipped with GRIFFON multi-role armoured vehicles and JAGUAR armoured reconnaissance and combat vehicles, to reach a level of interoperability with their French counterparts, already using the same vehicles, whereby a Belgian army unit can be seamlessly integrate with a French military operation, and vice versa.

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Photo: NATO



**While the lack of MLCs for many rural bridges across Eastern Europe may preclude their use for route planning, the availability of interoperable bridging and river crossing systems between allied partners will compensate, to a degree. Pictured is a US Army BRADLEY fighting vehicle crossing a Polish floating bridge at Zły Łęg lake during Exercise Allied Spirit 2020.**

As for its research reports, FINABEL stresses its studies are designed to drive discussion and further analysis about a particular theme, though comprising content that does not necessarily reflect the positions of member states. Let's now take a look at one of those studies to illustrate FINABEL's work; its report published in July, entitled: 'Interoperability and Military Mobility, An Assessment of the Functionality of Europe's Logistical Infrastructure'.

### Obsolete Infrastructure

In this study, researchers under the direction of FINABEL's Permanent Secretariat address and highlight concerns about the mobility of allied forces across Europe, kicking off with a NATO definition for military mobility as: 'the quality or capability of military forces, which permits them to move from place to place while retaining the ability to fulfil their primary mission'. It is a capabil-

ity, the study says, which has been largely neglected by both the EU and NATO since that definition was published in the Logistics Handbook in 1997. Indeed, from the time of the fall of the Soviet Union, investment in military transportation and infrastructure by western nations had been deprioritised until relatively recently, as the threat had, supposedly, gone. So, while the EU grew, together with European partners of the Transatlantic Alliance, and all parties enjoyed a Europe at peace, all these nations failed to invest in infrastructure projects that could equally be used by the military as they are for civil commercial purposes, e.g. rail. The study says the wake-up call came in 2014 with Russia's annexation of Crimea, violating the Ukraine, including its status as an EU Priority Partner; it also showed the west that its notion of Russia as no longer being a threat was wrong. But try getting defence materiel to the eastern flanks of the EU/NATO in the event of a further Russian attack using neglected and unworkable outdated infrastructure ... just not happening.

### Top Priorities

This FINABEL report says that top priorities for policymakers should be 'modernising and standardising infrastructure and bureaucratic procedures across Europe' so that 'interoperability and improved functionality and military readiness' can be facilitated and rapid deployment and movement of military forces and goods across Europe can be achieved. But it highlights obstacles, which would prevent this from happening, at this time, in the event a military conflict on the eastern flanks of the EU and NATO. Most obvious is that current and future-generation military equipment, often has physical dimensions higher, wider, and heavier than previous generations, making them incompatible with current tunnel heights, bridge load capacities (Military Load Classification – MLCs), and the differing gauge widths of various European railways. And in this context, incompatibility means impassable, non-transportable. So, the report firmly states structures need to be expanded and new ones constructed if Europe's infrastructure is to be fit for purpose to transport current and future generations of defence materiel quickly and securely to a rapidly-developing conflict.

And as if such physical obstacles are not enough, varying regulatory and procedural issues from state to state impact the smooth transportation of essential allied military assets across Europe. Lengthy and complex

### Towards European Tactical Communications Interoperability

The multi-national joint venture (JV), a4ESSOR (Alliance for ESSOR), to develop European Secure Software-Defined Radio (ESSOR) technology, announced in May that it had achieved formal acceptance for its High Data Rate (HDR) Base Waveform. This has been developed under the ESSOR OC1 (European Secure Software defined Radio - Operational Capability 1) contract with OCCAR (Organisation Conjointe de Coopération en matière d'Armement). The goal of the programme is to develop software-defined radio (SDR) architecture and the new ESSOR HDR WF, in order to achieve communications interoperability between European armed forces.

The ESSOR programme was initiated in 2009 under the umbrella of the European Defence Agency and is currently sponsored by the governments of Finland, France, Germany, Italy, Poland, and Spain, all Finabel member states. A crucial aim of its communications interoperability goal, is to enable European military units to co-operate effectively in any coalition operations.

Following 30 months of development work, a4ESSOR's JV partners -- Bittium (Finland), Indra (Spain), Leonardo (Italy), Radmor (Poland), Rohde & Schwarz (Germany) and Thales (France) -- will port the ESSOR HDR Base Waveform to their respective SDRs as part of the next phase of the project. Final interoperability tests between the partners' radios will complete the ESSOR OC1 project, after which improved and up-to-date ESSOR Target Waveforms will be ready to deploy operationally.





**If Europe's transportation infrastructure is to be fit for transporting allied defence materiel quickly to a developing conflict in the east, new structures need to be built. Pictured are British Heavy Equipment Transporters waiting to be driven off a roll-on/roll-off ferry in Belgium as part of the US-led multinational exercise DEFENDER-Europe 20.**

entry and exit procedures, diplomatic measures, customs requirements, particularly in relation to dangerous defence elements such as ammunition, all follow diverging sets of rules, nothing's standard, interoperable; a situation that hardly offers an effective, unified and efficient way of facing off rapidly against an aggressor that might already be on the move.

### The Trans-European Transport Network

Then there's FINABEL's additional concern, discussed briefly in the report, of the changing focus of the US, which it describes as 'gradually transferring its strategic centre of gravity to the Indo-Pacific region'. It postures the potential cutting of US defence spending on deterrence and

defence in Europe, which, in turn, could seriously impact military mobility and interoperability of trans-European lines of communication. And that brings us to the European Commission's Trans-European Transport Network, or TEN-T policy mention in the FINABEL report. What it emphasises is that while interoperability of armed forces on the battlefield is essential it means little without the support of effective, coordinated logistics and seamless lines of communication - rail, road, sea - to eliminate delays deploying equipment forward. It illustrates this, so, "It means, for instance, loading German tanks onto a Dutch cargo ship, which will be controlled in the port of destination by Estonian officials and brought into the area of operations using Lithuanian and Polish road and rail carriers, all supervised by

joint US-EU command and control units." At the moment, such movement already takes place for joint military exercises, though they incur multiple bureaucratic and non-standard equipment delays that must be ironed out - the aim of the EU's TEN-T plan, its intention to create a much more integrated logistics/transportation approach and existing infrastructure modernisation. The paper describes TEN-T networks as "a set of linear (railways, highways and waterways) and fixed (urban nodes, freight, airports) infrastructure assets strategically relevant at the European level and regulated by the EU Regulation 1315/201347." The overall project - to be completed by 2050 - aims to ensure accessibility to all EU regions, and its Core Network - to be completed by 2030 - consists of nine main multimodal corridors.

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**The goal of the ESSOR programme is to develop SDR architecture and the new ESSOR HDR WF, in order to achieve communications interoperability between European armed forces.**

FINABEL says with the huge variation in infrastructure types across the European region, TEN-T's policy to set uniformed standards and technical requirements for the whole infrastructure system is 'imperative', and the paper uses the Russian-gauge railroad tracks of the three EU and NATO-member Baltic States, as an example of the challenges to be overcome.

### Improving Interoperability

FINABEL's Interoperability and Military Mobility study goes into much greater detail than can be included here about dual-civil military infrastructures, harmonisation of procedures, communications corridors and sets out 10 'recommendations for improvement', reminding readers first that it was the 2014 Crimea event that has forced the EU and NATO to "improve and facilitate interoperability and military readiness across the European territory". The 10 recommendations include: Envis-

age the creation of a common secretariat; Harmonise cross-border movement permission procedures; Enhance EU-NATO joint training and exercises; Identify dual-use infrastructure projects; Adopt a common EU-NATO budget for infrastructure modernisation.

In its concluding remarks, the FINABEL authors state that 'harmonising cross-border movements through the modernisation of the existing transportation network has become the flagship of EU-NATO co-operation'.

FINABEL's efforts in developing and sharing such studies, forging links, driving discussion and action about interoperability between its 24 member states, as well as partners beyond its membership, are absolutely critical in the current, fast-moving geo-political and international security environment. They bolster already co-operative interoperability efforts, such as the 2016 and 2018 EU-NATO Joint Declarations, aimed at delivering 'swift and demonstrable progress' in military mobility across Europe, as discussed above. ■

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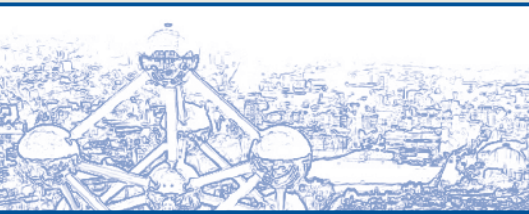
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# The Brussels Backdrop

Photo: author



## The Exit From Afghanistan

**Joris Verbeurgt**

On August 30, 2021, the last American soldier left Afghanistan, 20 years after the 9/11 terrorist attacks that triggered the intervention. The goal of the intervention was to bring Osama bin Laden to justice and to eradicate terrorist groups like Al Qaeda that held bases in Taliban-ruled Afghanistan. Twenty years presence of US and NATO troops in the country cost US\$2Trn. More than 3600 American and Allied soldiers lost their lives. The bomb explosion at the entrance of Kabul Airport in the last week of August, cost the lives of 13 American servicemen and scores of other people. The allied achievement? the Taliban conquered the whole of Afghanistan in a couple of weeks and is stronger than it has ever been. The Afghan Armed Forces, plagued by massive corruption and tribal divisions, didn't even try to put up a fight.

### What are the consequences of this fiasco?

For the Afghan people, the future looks grim: at best, the Taliban will be able to enforce Sharia law and order, making Afghan women the primary victims. At worst, a new civil war will break out, either between Taliban factions, or competing terrorist groups, or between the terrorists and the remnants of the Afghan Army that retreated to the North and are now hid-

ing in Tajikistan, waiting for a chance to come back. A new war will certainly destroy everything that was rebuilt in the past two decades. Furthermore, Afghanistan is again a safe haven for radical groups holding a grudge against the West: Al Qaeda may be "gone", but the ISIS network and other jihadist groups are alive and well, as the bomb attack on Kabul Airport, perpetrated by ISIS-K, has proven.

The US, on top of the financial and human toil, has to face another big failure in its foreign and defence policy. For the second time in its history, the biggest, technologically most advanced and most expensive army in the world, has not been able to defeat guerilla fighters wearing sandals and armed with Kalashnikovs. The US will have to adapt its armed forces in accordance with the lessons learned. An important lesson is that one cannot win a country with a military top-down strategy.

The countries of the EU have again demonstrated their powerlessness: without the support of the US, European nations were unable to continue the evacuation operations from Kabul Airport since they lack the resources. The EU should really start building an own credible defence capability. Whether that is within or outside the NATO structure is even irrelevant in this

case. Another lesson for the EU should be that nobody actually listens anymore when Brussels speaks: talk without substance does not generate respect, not from the allies and certainly not from the adversaries. Then there is the possible refugee: for now, there are no signs of Afghans massively fleeing their country, seeking asylum in Europe. But that may become reality when a new war breaks out or when Taliban rule becomes too hard to bear.

China started negotiations with the Taliban even before Kabul was taken. China's foreign policy is strictly based on its own security and economic interests, with complete disregard for human rights or democratic values. The loss of face of the Western interventionist powers causes laughter in Beijing, that feels strengthened by this debacle and may begin taking a harder stance on Taiwan, for example. For China, Afghanistan is interesting because of its resources (Afghanistan has one of the highest reserves of lithium) and because the country borders its autonomous region of Xinjiang where the Uyghurs, a Muslim minority, are causing some trouble.

It will be necessary to involve the regional powers (including Pakistan) to stabilise Afghanistan. The coming weeks and months may be crucial.

# Protecting the Baltics

**Giulia Tilenni**

While the Biden Administration and the EU have started to work on the normalisation of their ties with Russia, Moscow's threat remains a vital source of concern for Baltic states. As a NATO or EU intervention in case of attack cannot be taken for granted, the three countries have been extensively working on strengthening the readiness of their armed forces, individually but also together.

With Estonia, Latvia and Lithuania joining NATO and the EU, the borders of the two organisations, and especially those of the Alliance, experienced important modifications. The EU has bordered Russia since Sweden and Finland became members in 1995, and NATO has bordered Russia since 1999, when Poland gained membership. The NATO–Russian border, previously limited to the Kaliningrad exclave, broadened when the Baltic states joined. This sort of transformation into buffer states has a significant political impact. On the one hand, it exacerbates mutual misperceptions between the Alliance and Moscow, especially when it comes to military exercises taking place in the Baltics, alongside the Russian border or in the Kaliningrad exclave. On the other hand, the significant presence of Russian speaking people in the three countries (about one million out of the six total), leaves room for important influence campaigns. The Russian presence in Ukraine since 2014, the current political situation in Belarus and the almost continuous build-up of Russian forces along the country's Western borders are only the main demonstrations of the extent of the threat for the Baltic states. If a conventional Russian intervention in the Baltics is highly unlikely, cyber and hybrid threats are growing in intensity and dangerousness. If all Baltic states are concerned about Russia, the threats they are faced with are not the same. Due to the high number of ethnic Russians, Latvia and Estonia are more concerned by "little green men", the masked Russian soldiers in unmarked green army uniforms who appeared during the 2014 Ukrainian crisis. Consequently, these two countries are focuses on homeland defence, whereas Lithuania is focused on resisting a direct Russian invasion.

Photo: U.S. Army / Staff Sgt. Keith Anderson



**US soldiers dismount a BRADLEY Fighting Vehicle and advance on a target as Hungarian soldiers in BTR-80 armoured personnel carriers and dismounted Hungarian soldiers provide suppressing fire, during a NATO demonstration.**

## Mitigating Uncertainty about Collective Defence

Being the three defence budgets barely sufficient to ensure basic Armed forces' missions, the role of partners is crucial for the survival of Baltic countries. Despite the participation in European programmes, the EU is not given a major role when it comes to defence, the launch of a proper military operation in case of Russian aggression being unlikely. Conversely, Baltic states are aware NATO is essential to them – in military and political terms. As NATO membership per se implies primary deterrence against the Russian symmetric threat, the three countries are trying to boost their contribution to NATO to gain as many bargaining chips as possible. The redeployment of soldiers in military operations carried out within or outside multilateral frameworks and the participation to common defence projects are all intended to reaffirm this reliability. Moreover, their defence-related strategic documents, all based on NATO's Defence

planning process, clearly identify NATO as the most important partner. Estonia, Latvia, and Lithuania have been among the first states to meet the objective of spending at least 2% of GDP for defence, as NATO members agreed on in 2014. They have also extensively worked to ameliorate the interoperability of their military infrastructures and facilities and increase the number of assets pledged to the organisation, for instance in the countermine and the cyber domains.

As NATO members, Estonia, Latvia, and Lithuania should not be overconcerned about their limited capabilities and the lack of cutting-edge military technologies. Since July 2017, four Battlegroups are fully deployed in the Baltics and in Poland as part of NATO's strengthened deterrence and defence posture. Canada is the framework nation Latvia, where it operates in Adazi with the contribution of Albania, the Czech Republic, Iceland, Italy, Montenegro, Poland, Slovakia, Slovenia, and Spain. Lithuania, Germany leads the Battlegroup, head-

## Author

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Photo: US Army / Staff Sgt. Vanessa Hernandez

**A US Army CH-47 CHINOOK on Lielvarde Airbase, Latvia, during NATO exercise STEADFAST JAVELIN, a NATO exercise involving over 2,000 troops from 10 nations which takes place across Estonia, Germany Latvia, Lithuania and Poland.**

quartered in Rukla, with the contribution of Belgium, the Czech Republic, Iceland, Luxembourg, the Netherlands, and Norway. The Battlegroup based in Tapa, Estonia, operates as part of the 1st Infantry Brigade. It is led by the UK with the contribution of France and Iceland. Moreover, NATO has been protecting the Baltic skies since 2004, through NATO Air Policing mission, which has been enhanced in the last years.

In addition to this permanent NATO presence in the countries, the Article V of the NATO Charter should ensure full protection from allies in case of Russian aggression. However, Riga, Tallin and Vilnius cannot take collective defence for granted. Divides among NATO members might make reaching a consensus on article V too long or impossible, as some states might not accept going to war for Latvia, Estonia, or Lithuania. Should a prompt consensus be reached at the NATO level, the deployment of NATO troops might be slow, while 24/48 hours might be enough for Russians to storm or besiege Riga, Tallin or Vilnius. The fact that Russia would probably go for a hybrid form of aggression is an additional source of complexity, as this might not fall under article V.

## Building Autonomous Capabilities

For all these considerations, Baltic states are keeping upgrading and expanding their armed forces, but also to reinforcing their non-conventional capabilities, especially in the domains of cyber security and societal resilience.

### Estonia

In 2021, defence spending will raise to EUR645.5M, which is 2.29% of projected GDP. A total of EUR46M will be added in 2022 to the National Defence Investment Programme, which will be maintained at the current level of EUR20M per year throughout the state budget strategy period. The Estonian National Defence Development Plan 2017–2026 envisages the amelioration of Estonian combat readiness by expanding and improving the combat capabilities of its Armed forces. The wartime rapid response structure will grow from 21000 to 25000 troops and will be armed and equipped according to the objectives. The 1<sup>st</sup> Infantry Brigade will become a mechanized force ready for engagement

thanks to the procurement of 44 BAE System CV9035 Infantry Fighting Vehicles purchased from the Netherlands, FGM-148 JAVELIN third generation anti-tank missiles (to also equip the 2nd Brigade), at least 12 South Korean K9 Thunder self-propelled howitzer, and Armoured Personnel Carriers to equip the Kalev's and Viru's manoeuvring brigades. The 2nd Infantry Brigade will be transformed into a combat capable motorized force with a strong fighting ethic, with an infantry battalion and an artillery battalion to be added to its current structure. Air policing will continue to be at the heart of the country's aerial defence, but UAVs will be procured to support military intelligence and early warning capabilities. Concerning territorial defence, more than 10 light infantry companies will reinforce the existing defence structure, to progressively increase from 3200 to 4000 conscripts. Volunteers' level of training will be maintained at a high level thanks to the upgrade of the Defence League's infrastructure.

### Latvia

Defence Ministry's planned expenditures for 2021 will reach EUR694, marking an increase compared to last year.

The 2020-2024 State Defence Concept 2020-2024 identifies the four pillars of the deterrence-based Latvia's defence strategy: the reinforcement of national armed forces to ensure adequate defence capabilities, the development of a comprehensive defence, the strengthening of NATO collective defence, and the enhancement of international cooperation.

The Concept stresses that current defence spending levels will barely be sufficient for maintaining Armed forces' core functions.



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**US soldiers move under smoke during an exercise with the Estonian Army, part of Operation ATLANTIC RESOLVE 2015 in Tapa training area, Estonia. ATLANTIC RESOLVE is a US Army Europe-led land training mission taking place across Estonia, Latvia, Lithuania and Poland to enhance interoperability and demonstrate US commitment to NATO.**

If the development of capabilities such as medium-range air and missile defence, active defence at sea and long-range indirect fire support remain long-term goals, the country will be forced to rely on Allies to fill capability gaps, both in military and financial terms.

The professional army will reach 8000 troops by the end of the period, and the National guard, considered indispensable for the defence of the country's integrity, will increase to 10000 by 2024 and to 12000 by 2027.

## Lithuania

The Defence budget for 2021 reaches EUR1B, with a slight decrease compared

to 2020. More than 30% of the defence budget is allocated to the main priorities: the modernisation of the Army, the strengthening of deterrence and collective defence, strategic intelligence, cyber and information security, and public participation in strengthening national security. Between 2020 and 2024, around EUR1.3B will be devoted to the modernisation of Lithuanian Armed forces – about EUR100M more than for the 2014-2019 period. After those concerning Infantry Fighting Vehicles, self-propelled howitzers and medium-range air defence systems, all completed in 2020, the ongoing modernisation programme will focus on the procurement of one MCM ship, armoured all-terrain vehicles (2024) and medium sized utility helicopters to replace obsolete Russian-made Mi-8 (2025).

## Final Considerations

The three Baltic states have been trying to demonstrate their reliability to NATO and EU partners in the last decade through the raise of defence spending and the amelioration of their military capabilities. On May 21, the leaders of the three countries states officially launched preparatory works for the possible acquisition of multiple-launch rocket systems to enter service around 2025, which might become the first joint procurement programme among Baltic states. "We believe that NATO needs to send a clear and strong message about the Russian threat and make collective defence the most important task of the alliance in the next decade", Estonian Defence Minister Kalle Laanet said on that occasion. However, hope of Baltic leaders has somehow been deceived some weeks after, during the first NATO summit under the

Biden Presidency. The Alliance has recognised the need to "continue to respond to the deteriorating security environment by enhancing our deterrence and defence posture, including by a forward presence in the eastern part of the Alliance." It also condemned the Russian military build-up, its direct interference in Ukraine, Georgia and Moldova and the use of proxies to destabilise the political, economic, and societal functioning of certain countries. However, Chinese ambitions and assertive behaviour have been identified as possible threats to the Alliance, with a focus on the participation in Russian exercises in the Euro-Atlantic area. Growing attention towards China and the opening to dialogue with Russia are becoming hot topics on both US and the EU agendas. Mid-June, Presidents Biden and Putin agreed to launch a bilateral dialogue on strategic stability to "lay the groundwork for future arms control and risk reduction measures". Some weeks later, "professional and substantive" discussions, as they were defined by US and Russian representatives, took place in Geneva. Other meetings are to follow in September, with the establishments of working groups. On the EU side, Chancellor Merkel and President Macron proposed to hold formal talks with President Putin following bilateral meetings with him in the last months. The fact that the other European countries rejected their proposal could not be enough to reassure Baltic states. With the end of the Merkel era and approaching elections in France, the impetus the two leaders have tried to give to European defence and programmes that stemmed from it, mainly under PESCO and the European defence fund, is at stake. In addition to this uncertainty over partners' political agendas, hybrid threats against Baltic states are gaining momentum. In June and July, the number of migrants reaching Lithuania from Belarus has reached more than 2000 people – they were less than a hundred last March. This unprecedented migratory pressure has forced the country to ask for the activation of the EU Civil Protection Mechanism and the help of Frontex to make border monitoring more effective. Moreover, a physical border is under construction to stop illegal arrivals. According to Lithuanian authorities, the Belarus government is encouraging border crossing, as Russia has already done in the past, letting migrants reach Norway and Finland. Per these considerations, societal resilience and the strengthening of armed forces preparedness will likely remain crucial issues for Baltic states. ■



Photo: US Army

**NATO soldiers from The Netherlands, Germany and Romania practise an air assault operation during exercise DEFENDER-Europe 21, a large-scale US Army-led exercise designed to build readiness and interoperability between the US, NATO allies and partner militaries.**



# NATO Deployment and Management in Eastern Europe

Suman Sharma

NATO's enhanced forward presence in eastern and south-eastern Europe is seen as the biggest reinforcement in collective defence in a generation.

NATO Secretary General Jens Stoltenberg prior to US President Joe Biden's maiden NATO visit after assuming office, said, "We have implemented the biggest reinforcement of our collective defence since the end of the Cold War, triggered by the aggressive actions we saw in 2014, when Russia illegally annexed Crimea. It's a completely new thing. We have air policing, we have increased our presence in the Black Sea, in the Baltic Sea. And we have significantly increased the readiness of forces."

NATO has enhanced its forward presence in the eastern part of the Alliance, with four multinational battalion-size battlegroups in Estonia, Latvia, Lithuania and Poland, on a rotational basis. USA, UK, Canada and Germany lead these battlegroups comprising combat-ready troops from member nations along with capabilities on land, air and sea. Increased training exercises using air assets by member states have improved combat readiness thereby contributing to situational awareness. Furthermore, more maritime exercises are taking place, in addition to an increase in the number of ships deployed, along with placing land assets in the south-east of the continent. The multinational brigade, under Multinational Division South-East headquartered in Romania is the core behind these battlegroups.. Rapid reinforcement by supplementary forces and capabilities will be utilised to replenish these forward troops.

The action was defended by Director for Operations in NATO's Operations Division, Burcu San, at a virtual meet earlier this year, saying that it was a "Response to Russia's illegal and illegitimate annexation of Crimea, ongoing destabilisation of eastern Ukraine, and military build-up in the Baltic region and beyond."

All eyes were on Brussels during President Biden's maiden visit to NATO headquarters

Photo: U.S. Army / Spc. Osvaldo Fuentes



**Romanian Land Forces "Sky Guardians" fire their anti-aircraft GEPARDs during a live fire at Bemowo Piskie Training Area, Poland, in July 2021.**

in June. When asked about the inclusion of Ukraine into NATO he said, "It remains to be seen, meanwhile we will do all we can to put Ukraine in a position for it to continue to resist Russian physical aggression." Ukraine has been trying to join NATO since 2008.

A Ukrainian Army officer, on condition of anonymity says, "NATO's forward presence is not a trigger but a reaction to Russia's actions. The Russian narrative is part of its propaganda to defend itself from an "aggressive NATO".

In a recent meet between Ukrainian Deputy Prime Minister Oleksiy Reznikov and NATO Deputy Secretary General Mircea Geoana, interest was expressed in sending a mission to Ukraine to combat hybrid threats. Briefing international partners on the consultations within the Tripartite Contact Group on Ukraine (comprised of Ukraine, Russia, and the OSCE), Ukraine is able to highlight the Rus-

sian armed aggression against Ukraine and the occupation of parts of Ukrainian territories. In this regard, Reznikov mentioned,

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**US Army soldiers conduct a march at Bemowo Piskie Training Area, Poland, 16 July 2021.**

"Ukraine has fulfilled all the obligations of the summit of the leaders of the Quartet of Normandy in Paris in 2019. Instead, Russia has done nothing and is trying to block consultations by resorting to blackmail and escalation. The main thing is that NATO has a clear awareness that Moscow is a party to the international armed conflict."

## NATO-Russia Founding Act

The NATO-Russia Founding Act of May 1997 is often seen by experts as a 'dead letter'. The Pact, initiated for consultation and cooperation, was more of a political agreement rather than a legally binding document, which included no deployment of NATO troops on former Warsaw Pact territories, but the Pact lost significance after March 2014 following Russia's annexation of Crimea. The idea was to keep Europe undivided, but with new geo-political entities emerging, such as the recent agreement on Nord Stream-2, the energy pipeline from Russia to Germany via the Baltic, has only further divided Europe. Many have called Nord Stream-2 more geo-political than an actual energy agreement. With NATO enhancing its troops in the region, Moscow has vowed to retaliate.

George Friedman, writes in 'Geopolitical Futures', "Ukraine's Orange Revolution in 2004 was the breaking point, along with the admission of the Baltic states into NATO. The Russians saw the latter as a violation of the West's pledge not to expand NATO into the former Soviet Union, and the former as a desire to build anti-Russian regimes in areas of vital interest to the Russians."

## The Suwalki Gap

In a 2018 report by LtGen (Retd) Ben Hodges for the Centre for European Policy Analysis speaks of the Suwalki Gap, a sixty-five km wide stretch of land between Kaliningrad, Belarus, Lithuania and Poland, which has two highways which would be used by NATO in the eventuality of a conflict between Russia and the Baltic states.

Kaliningrad, bordering northern Poland, is home to the Russian Navy's Black Sea Fleet,

where approximately 15,000 troops are deployed, in addition to long-range ballistic missiles and heavy artillery, all of which are a cause for concern for Poland and Lithuania. The Gap could be interdicted by Russian land forces to attack NATO bases.

The Report broadly underlines the following findings:

- The Suwalki Corridor is where the many weaknesses in NATO's strategy and force posture converge. Suwalki is NATO's corridor and Russia's gap.
- Most concerning for NATO is Russia's sizeable build-up of conventional land forces inside Kaliningrad.
- Russia benefits from a numerical advantage over NATO forces facing the Eastern Flank in terms of manpower and in every major category of combat weaponry.
- The best deterrence against Russia is a multi-layered one.
- Moscow's strategic objective in Europe is to disrupt, divide, make irrelevant, or eliminate NATO as a security organisation and defence guarantor.
- Russia's 21st century warfighting is ambiguous, deceptive, multi-pronged, and exceptionally effective.
- The most effective deterrent is the one that leads Russia to avoid testing NATO in the first place.
- Russia's methods of warfare are changing.

## Troops on Rotation

NATO's multinational battalions have been serving on a rotational basis since 2016, mostly in Poland and the Baltics. But personnel and equipment deployed on a rotational basis can prove an expensive affair. It has been seen to be more costly than permanently located troops at bases. Costs associated with infrastructure, training, logistics that NATO will face with any forward troop deployment are expensive and whether that approach will elicit the desired results in terms of efficacy is yet to be ascertained. The deterrence that NATO is seeking in the East by posturing itself as an efficient and effective force is still to be seen.

In July this year, NATO allies signed an MoU to modernise the storage and pro-

vision of ammunition. Under the new Multinational Ammunition Warehousing Initiative, signatory member states are expected to come up with common precepts pertaining to storage and management of ammunition stockpiles in various multinational warehouse locations.

This new concept also allows for the creation of storage facilities on a temporary basis supporting NATO missions, where munitions can be stored by Allies during deployment. This initiative has been propagated with the aim of reducing costs for deploying and removing munitions for every single new deployment cycle. The first location under this initiative is expected to be operationalised before the end of 2021.

Military watchers have also spoken about tripwire forces, which troops from several NATO members deployed in the Baltic states are believed to be. Tripwire is a small force usually placed to deter the aggressor so as to prevent a full engagement. Soviet troops deployed in Cuba in the 1970s were deployed as a tripwire force.

Mechanised battalions armed with infantry combat vehicles and third generation CHALLENGER-2 main battle tanks of the British land forces stationed in Estonia are the tripwire response to the heavy investment by Russia in the past few years in acquiring modern military capabilities. Mechanised assets of countries like Germany, Poland and Canada, with reinforcements from Czech, Norwegian and Dutch companies, along with self-propelled howitzers provide the necessary cover to the Baltic states. US armoured regiments armed with ABRAM tanks and BRADLEY vehicles are other committed assets. Smaller member nations like Montenegro, Iceland, Albania, and Luxembourg are contributing smaller contingents.

Cyber tools add another dimension in Russia's 360 degree hybrid warfare approach, causing concern for all NATO allies. A 2016 war-game report by the American policy think-tank RAND Corporation, says, "Across multiple plays of the game, Russian forces eliminated or bypassed all resistance and were at the gates of or actually entering Riga, Tallinn, or both, between 36 and 60 hours after the start of hostilities. Against an adversary such as Russia, that poses multidimensional threats, air power must be employed from the outset of hostilities to enable land operations, and land power must be leveraged to enable air power."

While Europe may be fragmented geo-politically, it seeks stability as nations like Poland, the Baltics, Hungary, Slovakia, Bulgaria and Romania are feeling the winds of a militarily expanding Russia. ■



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# New European Attack Helicopters: Eagerly Awaited by 2025

**Georg Mader**

Most European nations are currently focusing on increasing the capability of their defence forces. One aspect of this is the procurement of new attack helicopters. Various armies now have more than 140 new or upgraded platforms on order. By the middle of the decade, European military aviation is due to receive new fleets, remarkably overwhelmingly indigenously developed.

Europe's market for this so-called upper class of military rotors, by various forecasts is expected to exhibit a growth rate of more than 4 per cent until 2025. Due to a more robust Russia in recent years, potential counter-terrorism contributions abroad, and possible sea-based intrusions, the - modest to significant - growth in military spending by most European nations is driving the development of attack helicopters. The deployment of national forces in hot spots such as the Middle East or Sub-Saharan Africa is also propelling the growth of this particular defence sector. Technological advancements in electronic warfare technology, stealth and advanced air-to-surface attack weapons are also rapidly driving the demand for new platforms. Armed Forces are undertaking procurement via new platforms and/or upgrading existing fleets, either by indigenous European efforts, or from the US or Russia.

Photo: AdT



**A French TIGER-HAD in Mali**

Photo: Airbus



**A TIGER HAD-E for the Spanish Air Force**

## Usual Players and Mission Sets

The attack helicopter market in Europe is highly consolidated – even dominated - with a few players such as Leonardo S.p.A., Airbus Helicopters, Boeing, Bell-Textron Inc. or Rostec State Corporation. These manufacturers are heavily investing in the development of advanced next-generation assault helicopters, with better lethality and increased situational awareness. Developments of new product lines by these companies that suit the present and expected combat needs of

domestic forces are expected to lead to a growth of company order books over the coming years. Today's best attack helicopters are merely mission-specific gunships. Making them viable for an Army or Air Force is emphasising their multi-role capabilities, such as gunship, anti-armour, general ground attack, armed reconnaissance, fire support/escort, covering landing zones, deep penetration missions - and as is to be expected in the future, more of a 'networking warrior'.

## AW249

The Italian manufacturer is advancing development of the all new AW249 attack helicopter. A €487M multi-year development contract under Italy's New Exploration and Escort Helicopter (NEES) programme, was issued by Rome in 2017, with the aim of replacing the AW129 in Italian Army service starting in 2025. The company will produce one AW249 prototype, as well as three initial produc-

## Author

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tion aircraft. The Italian Army's Aviation unit has outlined a total requirement for 48 aircraft in total, as part of a €2.77Bn (US\$ 3.3Bn) budget, as shown in briefing documents from the Italian Senate. While a first flight might be undertaken before the end of the year, the manufacturer has remained rather tight-lipped about the platform's development. But it is known that the aircraft will be based on the existing and proven dynamic systems of the AW149, with Leonardo wrapping the attack helicopter fuselage and systems solutions designed for the AW129 MANGUSTA around them, in order to save development time and money. The AW249 will also use the 2,500-shp General Electric CT7-8E6 turboshaft the Army recently revealed on its website. The same engine is used on the AW149 and on Italy's NH90 fleet, simplifying logistics chains and support programmes. However, the certification of Safran's ANETO engine on the AW149 and its commercial derivative, the AW189, could enable that engine's use on the AW249 as well. Existing MANGUSTA armaments will also be used, including its TM 197B 20 mm nose-mounted gun and the SPIKE missile system.



Photo: Bundeswehr

#### **A German TIGER in hover**

With a maximum take-off weight of 7.5 to 8 metric tons, the AW249 is almost twice as heavy as the Italian MANGUSTA. This additional weight reflects calls for increased endurance, a larger weapons capacity and new capabilities, including battlefield management systems and tactical data links. Leonardo adds that the platform will provide increased situational awareness, enhanced interoperability and manned-unmanned teaming (MUM-T) capabilities. The latter capabil-

ity will allow the AW249 to 'team up' with a number of unmanned aircraft systems (UAS) that act as a force multiplier to enhance lethality, survivability and situational understanding.

#### **ATAK-2**

Although Italy and Turkey cooperated on the development of the T129, Turkey is taking an independent route in developing its next-generation attack helicopter.



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Photo: TAI



**A T-929 ATAK-2 mock-up in June 2021**

Photo: WLP



**Polish Mi-24s to be replaced**

TAI's so-called Heavy-Class Attack Helicopter, often referred to as the T929 or ATAK-2 is being developed off the back of the company's growing experience with the T129 and its indigenous development of the T625 GOKBEY utility helicopter. The design is in the 11-ton class and will carry 1,500 kg of ordnance, with the greater size coming in response to

demands for increased weapons payload and endurance, as well as hot-and-high performance for operations in the country's uneasy and sensitive south-eastern regions. That said, the ATAK 2 will be similar in size to Boeing's AH-64 APACHE and be much larger than its predecessor. Full-scale development of the ATAK-2 was announced in February 2019, with

a contract for TAI by Ankara's defence materiel agency SSB and plans for a prototype's maiden flight by 2024.

Quite noteworthy in this respect is that, according to Temel Kotil, Chairperson of Turkish Aerospace Industries (TAI) to Haber Türk TV in March, ATAK-2 would use 2,500 shp engines purchased from Ukraine's Motor Sich. This was then signed on 29 June, with the first two power plants to be delivered in a year from now.

In the meantime, TAI is continuing its development of a configuration of the current T129, called the Faz-2 (Phase-2) and not to be confused with the future ATAK-2. This variant comes with an enhanced self-protection suite for electronic warfare (EW) and countermeasure capabilities such as laser- and radar-warning sensors. Regarding the ATAK-Phase-2 (or maybe also later to be named T129B) for the Turkish Army Aviation, TAI president Serdar Demir noted that the more powerful, updated helicopters will be delivered from the second half of the year onwards. TAI has so far delivered 53 basic T129 ATAK helicopters and in the initial phase, the plan is to deliver 21 reconfigured ATAK helicopters. Demir briefed Turkish media this February: "The ATAK-Phase-2, equipped with a laser warning system and upgraded electronic warfare systems, is in the air. Phase-2 configuration includes additional EW-systems such as a laser warning receiver, a radio frequency jammer, a radar warning system and a 9681 V/UHF Radio."

### TIGER Mk.3

Initially thought of as an anti-tank platform able to counter a Soviet armoured invasion, the Franco-German TIGER eventually transformed into a multi-role attack helicopter, with several variants developed to fit the different needs of its current operators, France, Germany, Spain and Australia. In January 2020, Airbus-Helicopters (AH) completed the delivery of the final TIGER-HAD-E to the Spanish Army as a part of the contract to supply 18 attack helicopters. This variant comes with Kevlar ballistic protection and self-sealing tanks, providing a high level of crashworthiness and survivability.

A long-awaited plan to upgrade the TIGER is still awaiting a contract, six years after architecture studies were announced in 2015. In May 2018, France and Germany formalised the modernisation of the TIGER, defined by the French Minister of the Armed Forces as a "new stage for Europe of defence and the consolidation of our industry." On behalf of France, Germany, and Spain, the European Organisation for

Photo: TAI



**Turk ATAK-2- features**



Joint Armament Cooperation (OCCAR) as the European procurement authority, three months later contracted the manufacturers involved in the project, TIGER Mk.3, namely Airbus Helicopters, Thales and MBDA, to carry out risk reduction studies for the improvement, which would extend to the avionics, mission and weapon systems. The Mk.3 programme is expected - or hoped - to bring greater commonality and reduced obsolescence to the TIGER fleets of the three European operators. Australia, as the fourth operator, however opted to replace its 22 aircraft, citing low availability versus increasing operational costs. And only this January, Australia's Defence Minister Linda Reynolds announced the acquisition of 29 Boeing AH-64E APACHE helicopters from 2025 on, at a cost of US\$3.5Bn.

In the Mk.3, the existing cells would be retained, thus no newly-built helicopters are planned to be built for Germany. These would basically be completely refurbished and provided with new sensors and weapons integration. At the same time, new avionics are imperative. This would have to go hand-in-hand with an extension of the service life of the cells from 20 years now to 30 years, targeting an end of use in 2048. When converting to Mk.3, one or two machines would run through in the first year, then three to four a year. Around 20 machines are necessary to be operationally ready. If one calculates ideally with an influx of aircraft from 2029, a readiness for action from 2034, and an end from the mid-2040s, the question of comparison of costs and benefits is raised. However, older machines would be phased out as early as the beginning of the 2040s, also meaning that from around the mid-2040s there



**Rendering of the Turkish ATAK-2 helicopter**

would no longer be enough machines available for operational use.

### Hesitant Germany

With the last German TIGER aircraft delivered from 2018, the Heeresflieger are already investing in the modernisation and maintenance-improvement of their existing fleet, after fatal accidents in 2019. However, it now appears that the German side looks hesitant to see the planned update move forward at all. After the Franco-German Council on Defence and Security held on February 5, 2021, German Chancellor Angela Merkel said that "for the TIGER-3 standard, there is a whole series of negotiations yet to be conducted, in particular with Airbus for the part of Germany!" In its 2018 "Report on the material situation of the main armament systems of the Bundeswehr", the BMVg revealed that on average, only 11.6 out of its 53 helicopters were operational. In January 2020, the German media outlet Bild said that this number had

dropped to eight. If unmodified, the useful life of the Bundeswehr's combat helicopters will be reached in 2030. With an upgrade, the platform would be operational for the next few decades. The focus of this upgrade is on renewing and expanding the weapon systems. With the improvements, the attack helicopter would fight more effectively and be superior to the competition says Airbus press spokesman Gregor Kursell. Meanwhile, the French defence think-tank Mars reported in La Tribune that Berlin could make its withdrawal from the TIGER programme official by autumn 2021. And a year ago however, the German Government mentioned plans to acquire APACHE AH-64E in the coming years and that it has issued a subsequent information request to the United States Government for the deal.

### Various Armament Options

Regarding ordnance, Germany's aircraft - delivered in the UHT-configuration - differ considerably from those of France and

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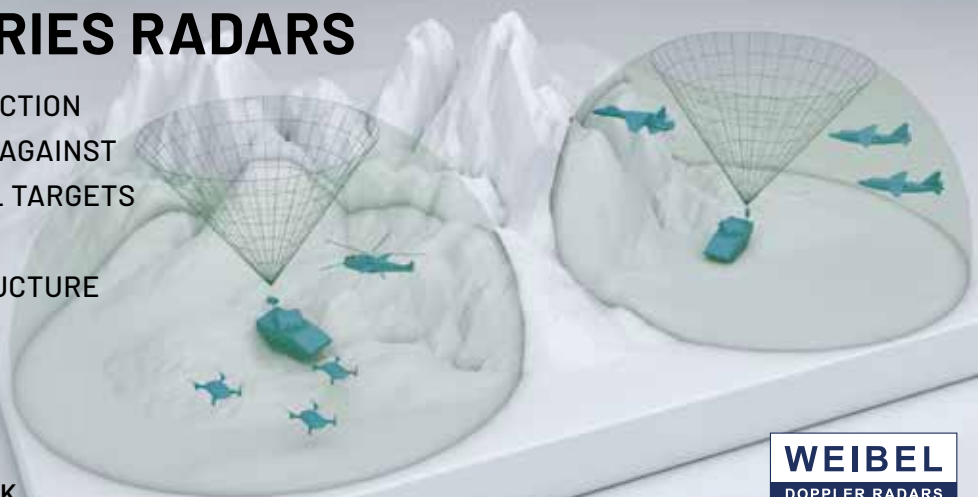


Photo: Georg Mader



**Roketsan armaments for the T-129 ATAK helicopter**

Photo: Leonardo



**A concept drawing of Leonardo's AW249**

Spain, which both now fly the HAD version. All three countries currently use a different missile as the type's primary weapon. Proposals to introduce a common weapon for the three countries appear to have been shelved. Spain plans to continue to use the Rafael SPIKE missile and Germany is expected to adopt the same weapon for its TIGERs, after abandoning the introduction of the expensive MBDA PARS 3LR munition. Thales and Rheinmetall in late 2020 have formally unveiled a new 70 mm rocket launcher for the TIGER Mk.3 attack helicopter programme. The FZ606 is a modular six-tube rocket launcher for FZ275 laser-guided rockets or a combination of guided and unguided projectiles. It is designed to bridge the gap between costly long-range missiles, short-range guns and inaccurate unguided rockets and is the first product of its kind to offer a 'Lock-On-Before-Launch capability' – a feature usually only available with missile systems. The launcher was tested

in mid-2020 in Belgium. Design, development and production of the NATO-calibre system are part of a European collaborative project conducted by Thales and Rheinmetall under a partnership agreement signed by the two companies at the end of 2019.

### French TIGER (or TIGRE)

The TIGRE (French spelling) is the spearhead of French Army aviation (ALAT - Aviation Légère de l'Armée de Terre) and was first deployed to Afghanistan in mid-2009. This was followed by Opérations Harmattan (Libya 2011), Sangaris (CAR 2013) and today, Barkhane in Mali. The ALAT currently operates 67 airframes of two versions of the TIGRE but any domestic upgrade programme – ahead of any Mk.3-breakthrough - currently underway should result in commonality across the entire fleet. Two standard ALAT regiments operate the TIGRE: 1e RHC at Phalsbourg and

5e RHC at Pau in the south-west of the country and in addition, it is operated by 4e Régiment d'Hélicoptères des Forces Spéciales (Special Forces Helicopter Regiment), also based at Pau. While generally seen as a success, also in – compared to Germany – much more determined and combat oriented France, the TIGRE did draw some criticism. In 2018, the French MoD noted that there were 30 different service contracts only for the TIGRE, while confessing a poor availability of some 25 per cent of all types of ALAT-operated helicopters.

The baseline version is the TIGRE-HAP (Hélicoptère d'Appui Protection), which is capable of employing 68 mm rockets and the MISTRAL air-to-air missile, as well as the 30 mm chain gun in the nose. The second French variant is the HAD (Hélicoptère d'Appui Destruction), which is similar to the ARH in that it has laser designation capability and HELLFIRE II missiles, but it also has the enhanced MTR390-2C version of the Turbomeca-Rolls-Royce engine, which adds about 14 per cent more power. Since 2020, 36 surviving TIGRE-HAPs are currently being brought up to HAD standard by Airbus Helicopters in Marseille/Marignane and the work is expected to be completed by 2024. The entire fleet is also being upgraded to a Standard-2 configuration (also known as Mk.2), while the above mentioned Mk.3 upgrade – in parallel to the German 'pause' - is now in the de-risking phase. As the coordinator of the tri-national and also PESCO-supported TIGER Mk.3 project, France definitely wants this upgrade, since it is intended to maintain this variant in active service well beyond 2040. They also want to link the helicopter to the French Army's Scorpion C3-network for a collaborative combat approach. The modernisation includes fitting the contact software-defined tactical radio, new modular FlytX avionics-suite, a new targeting system and a new missile to replace the HELLFIRE II weapon. For that, the Direction Générale de l'Armement procurement office has subsequently turned to MBDA to develop a whole new weapon. This ordnance, called MAST-F, will be an air-launched derivative of the company's MMP man-portable anti-tank missile. MBDA says the weapon weighs 20 per cent less than competitors' offerings, providing weight savings that should allow the helicopter to carry more fuel. Proposals for MAST-F call for qualification firings to be conducted in 2026 and deliveries in 2028, potentially hinting at a timeline for when France expects the renewed attack helicopter to enter service.



## Stalling RAVEN...

From the Polish AF's 48 Mi-24D/Ws (including 16 former East German LSK examples), only 27 units are in use today, but their service lives are drawing to an end. In 2012, the service life of the last ATGMs (9M114 Szturm) expired, leaving them with 23 mm guns, large-calibre 12.7 mm machine guns and 57 mm unguided rockets for troop fire support. Therefore, in case of a future conflict scenario, the Mi-24s would need to operate within range of the enemy's MANPADS (currently ~6km) and vulnerable to heavy losses. Their long-awaited replacement – expected to be the largest such new deal of its kind in Europe – by the KRUK (RAVEN) attack helicopter programme however, still awaits a handful of key decisions and recommendations for further implementation to be made, and before a manufacturer is selected to produce new aircraft. The Ministry of National Defence (MND) has twice reset plans from a previous commitment to acquire 32 new aircraft. A renewed tender had been expected to commence in 2020, initially with up to 16 helicopters set to be delivered by 2026 — but maybe also due to the COVID-impact, no such progress was made and authorities now admit KRUK is currently at an analytical and conceptual phase. Nothing will be on the tarmac before 2024/5.

Whenever this RAVEN lifts off again, opportunities for a US-made platform are definitely greater, with Bell intended to offer its AH-1Z VIPER. With four of these destined for the Czech Republic – together with eight UH-1Ys making a total of





Photo: Georg Mader

### A Bell AH-1Z VIPER in Dubai

US\$ 272M – production has recently been re-launched. For many Polish observers, for some time now, the AH-64E APACHE GUARDIAN looks to be the frontrunner and Boeing has entered into cooperation/supplier agreements with Polish defence manufacturers, most of which are subsidiaries of the Polish Armaments Group. The

other likely alternative is Leonardo's above described AW249. Back in July 2018, Leonardo signed a letter of intent (LOI) with the same state-owned conglomerate – including its own local subsidiary PZL-Swidnik – to collaborate on the rotorcraft's development, production and servicing. If selected, of course...







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# Main Battle Tanks in NATO

**Christopher F. Foss**

The demise of the MBT has been predicted many times, especially after the heavy losses of Israel MBTs in Yom Kippur war and more recently the end of the Cold War in Europe as there was no immediate threat to NATO.

Events since then however have confirmed that the MBT, when used as part of the combat arms team with mechanised infantry, self-propelled (SP) artillery systems, combat engineers, aviation assets and the essential C4I elements, are a unique combination for manoeuvre operations. More recently, MBTs have seen extensive operations in the Middle East as well as in Iraq and Afghanistan where they have more often been used in the infantry direct fire support role rather than engaging other MBTs, which was their original role.

## Survivability Enhancements

Many of the Western MBTs were designed for conventional operations in Northern Europe, not operating in the high temperatures encountered in the Middle East against insurgents well versed in deploying improvised explosive devices (IED), mines and the widely deployed rocket propelled grenade (RPG) launcher. For this reason under Urgent Operational Requirement (UOR) funding, MBTs and many other types of armoured fighting vehicles (AFV) deployed to the Iraq and Afghanistan have been rapid upgraded to enhance their survivability. This has included installation of air conditioning systems, remote weapon station (RWS), cameras for enhanced situational awareness, electronic devices to counter IED and enhanced protection packages.

## The LEOPARD

Most countries in NATO have drastically reduced their Main Battle Tank (MBT) fleets since the end of the Cold War. Belgium

### Author

**Christopher F. Foss** has been writing on armoured fighting vehicles and artillery systems since 1970. He has also lectured on these subjects in many countries as well as chairing conferences all over the world. He has also driven over 50 tracked and wheeled AFVs.



**Artist's impression of German Army LEOPARD 2 A7A1 MBT fitted with the RAFAEL Advanced Defense Systems TROPHY hard kill active defence system**

has phased out of service all of its 105mm armed LEOPARD 1 MBTs while the Netherlands has phased out its LEOPARD 2 MBTs, although one Germany Army tank battalion has a company of LEOPARD 2 MBTs manned by Netherlands crews.

Canada did decide to phase out its LEOPARD 1 MBTs but subsequently reversed this decision and acquired a fleet of LEOPARD 2 MBTs some of which were upgraded by Krauss-Maffei Wegmann for deployment to Afghanistan. Other NATO countries still retain their MBTs as they can be used for offensive and defensive operations as part of the combined arms team.

Sweden (S-tank) and Switzerland (Pz 61 and Pz 68) both had the capability to design and manufacture a new MBT but in the end elected to procure the German Krauss-Maffei Wegmann LEOPARD 2 MBT with first units coming from the German production line followed by local production.

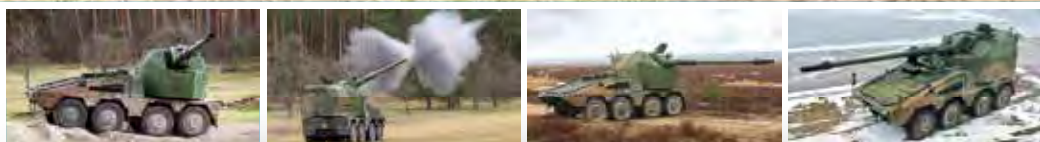
Following a competition, Greece and Spain also selected the LEOPARD 2 with first units from Germany followed by local production. To all intents and purposes, the LEOPARD 2 has become the standard MBT of NATO as

well as being exported to non-NATO countries including Austria, Chile, Finland, Indonesia, Kuwait, Singapore and Qatar. Some of these such as Kuwait and Qatar purchased brand new latest generation LEOPARD 2 MBTs plus supporting vehicles while other countries purchased second-hand vehicles which were usually refurbished prior to delivery. While there was once a glut of surplus LEOPARD 2 MBTs, this is no longer the case as significant numbers have been sold while others have been converted to carry out more specialised battlefield roles. The first LEOPARD 2 MBTs rolled off the production lines as far back as 1979 and in mid-2021 the latest LEOPARD 2A7 was again in production for Hungary as well as upgrade programmes underway for a number of countries.

## The LECLERC

The French Army took delivery of 406 Nexter LECLERC MBTs, with the United Arab Emirates (UAE) taking 426 (including armoured recovery vehicles), but some of the latter have now been transferred to Jordan.





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Photo: Nexter



**The French Army will retain 200 LECLERC MBTs which will be upgraded by Nexter Systems to extend their operational lives. The LECLERC is the only MBT in NATO armed with a 120 mm smooth-bore gun fed by an automatic loader.**

Production of the LECLERC turrets was undertaken at Tarbes while hull production and final integration was undertaken at the now Nexter facility at Roanne which is now building GRIFFON, JAGUAR and SERVAL wheeled AFV for the French Army. While the LEOPARD 2 and LECLERC MBTs have been upgraded to extend their operational lives, they will eventually have to be replaced.

## The MGCS

France and Germany have been working of the future MAIN GROUND COMBAT SYSTEM (MGCS) (European Security and Defence August 2020) since 2012 with a potential service date of around 2035. MGCS will consist of a family of vehicles with the MBT likely to feature the crew seated in the hull for maximum protection along similar lines to the Russian T-14 ARMATA MBT which is fitted with a remote controlled turret armed with a 125mm smooth-bore gun fed by an automatic loader. Main armament of the MGCS could be a Rheinmetall 130mm smooth-bore gun which has been undergoing firing trials for several years, a new Nexter 140mm smooth-bore gun or even an electro thermal chemical gun. There have been some attempts in the past for a common MBT including the MBT-70 which has a German/US project which reached the prototype stage before each country went its own way, with Germany developing the LEOPARD 2 and the US the M1 ABRAMS. Other countries could join the MGCS but it remains to be seen if this

does eventually enter service as technology is constantly changing as is the threat and some countries may well try and upgrade their existing platforms.

With any major internal programme there are always problems on work share which can depend on a number of factors such as quantities of vehicle and delivery dates required by the end user. The UK and US were jointly developing a new reconnaissance vehicle called TRACER (Tactical Reconnaissance Armoured Combat Equipment Requirement) but the USA pulled out to fund Future Combat System (FCS) which in turn was cancelled.

Photo: Rheinmetall



**CHALLENGER 2 demonstrator fitted with new turret armed with Rheinmetall 130mm smooth-bore gun**

There is also the thorny problem of exports. Many countries in the Middle East have wanted the LEOPARD 2 MBT but it is only in recently that Germany has relaxed export sales for Kuwait and Qatar who purchased the latest LEOPARD 2A7 optimised for use in the high temperatures encountered in the Middle East.

## The ALTAY

Apart from the LEOPARD 2, the only country in Europe, if one excludes Israel, to develop a new MBT is Turkey with their ALTAY MBT. This was developed under the leadership of Otokar who have produced large numbers of wheeled AFV for the home and export markets. Following trials with an ALTAY Mobility Test Rig (MTR) and a Firepower Test Rig (FTR) two prototype vehicles (PV1 and PV2) were built and put through their paces by the Turkish Land Forces Command (TLFC). The ALTAY production contract was however placed with the Turkish company of BMC who, while having extensive experience in the design and production of tactical wheeled vehicles and Mine Resistant Ambush Protected (MRAP) type vehicles, had no previous experience in the production of highly complex MBTs.

The first contract is for 250 ALTAY MBTs with a number of local contractors supplying key sub-systems such as Aselsan for the computerised fire control system (FCS) and optics and MKEK for the 120 mm smooth-bore gun and its ammunition. Prototypes of the ALTAY have a German MTU power pack consisting of engine, transmission and cooling system but production ALTAY will have a local power pack. The power pack is the most



complicated part of the hull and the number of contractors who can supply this are very limited and South Korea has had problems with designing a local power pack for their K2 MBT.

In recent years, the Turkish land forces industry has gone from strength to strength and today can offer export customers tracked and wheeled AFVs to meet almost all user requirements with major export contracts being won by Turkey in Africa, Middle East and Asia.

### The ABRAMS

The largest user of MBTs in NATO is the US Army with the latest version being the GDLS ABRAMS M1A2 SEPv3 which is an upgrade of an earlier version and has many enhancements at the sub-system level.

The US Army continues to invest in 120mm ammunition including the latest 120mm M829A4 APFSDS-T and the 120mm Advanced Multi-Purpose (AMP) round designated the XM1147 whilst under development. The AMP has four fuze modes and will replace the currently deployed M830A1, M1028, M830 and M908 1230 mm rounds currently deployed.



Photo: Christopher F. Foss

**Rheinmetall built a large number of LEOPARD 2 MBTs and for the export market has developed an export upgrade package which is today called the Tank Technology Testbed.**

Late in June 2021 it was announced that Poland would acquire 250 GDLS ABRAMS M1A2 SEPv3 MBTs as well as the essential ammunition, training and logistic support.

### Upgrades

Today, MBTs have a much longer life than in the past and are usually upgraded a number of times, not only to extend their

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Photo: Leonardo



**To meet the potential requirements of the export market, Leonardo has upgraded the M60 with a host of improvements, including a 120mm smooth-bore gun, new FCS and sights, a new power pack and additional armour.**

operational lives but also to enhance their capability. In addition, sub-systems need to be replaced as they are either obsolete or the original supplier is no longer in the defence business. In the key area of firepower, this can take the form of the installation of a larger calibre main armament, developing new ammunition with enhanced characteristics and upgrades to the FCS and sighting system. For example, the original US GDLS M1 ABRAMS MBT had a 105mm M68 rifled gun (a development of the British Royal Ordnance L7) that as was installed in the earlier M60A1 and M60A3 MBTs but the M1A1 ABRAMS and follow-on M1A2 ABRAMS had the M256 smooth-bore gun which is based on the Rheinmetall 120mm L44 smooth-bore gun and manufactured at Watervliet Arsenal. Rheinmetall subse-

quently developed the longer 120mm L55 smooth-bore gun which is installed in the LEOPARD 2 A6 MBT and this has been followed by the Rheinmetall 120mm L55A1 smooth-bore gun which enables more powerful 120mm ammunition to be fired.

### New Ammunition

As new generation MBTs have increased protection, new ammunition has been developed with enhanced penetration characteristics. The main tank-killing round is the armour-piercing fin stabilised discarding sabot (APFSDS) which typically has a dense long rod penetrator and usually has a tracer element so the gunner can see it in flight. The US and some other countries use depleted uranium (DU) for the penetrator due

to its enhanced penetration characteristics but this cannot be used in peacetime for environmental reasons and many countries will not use it under any circumstances.

In addition to APFSDS other natures are used including high-explosive anti-tank (HEAT), high-explosive squash head (HESH) and smoke. Due to the increased use of advanced armour solutions and explosive reactive armour (ERA), the effectiveness of HEAT ammunition is much reduced. More recently, 120mm air bursting munitions (ABM) have been developed and deployed and these are very useful when carrying out counter insurgency operations (COIN) that have been the main role of MBTs in Afghanistan and Iraq. The German Rheinmetall DM11 ABM has been sold to a number of countries including Indonesia and was used by US Marine Corps M1A1 ABRAMS MBTs in Afghanistan, although these MBTs have now been phased out of service and returned to the US Army.

Russia has used gun-launched laser guided projectiles (LGP) for many years but apart from the US 152 mm SHILLELAGH for the M551 SHERIDAN reconnaissance vehicle and US M60A2 MBT, both of which have now been phased out of service, NATO has not deployed any of this type of munition. The Turkish company of Roketsan is developing a 120mm LGP called TANOK which has a nose mounted semi-active laser (SAL) seeker and has both direct and top attack modes. It is fitted with a tandem HEAT warhead to enable targets fitted with ERA to be neutralised. Roketsan are quoting a maximum range of up to 6,000 m which is well beyond the range and of a conventional tank gun. Russia, and more recently China, have also developed and fielded LGP with the latest Russian 125 mm LGP being fitted with a tandem HEAT warhead.

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## Upgrades by Non-OEMS

While the original equipment manufacturer (OEM) is best placed to carry out this MBT upgrade work, this is not always the case and some governments open this up to competition to reduce costs. A good example is the German LEOPARD 2 MBT for which the OEM is Krauss-Maffei Wegmann but the German company Rheinmetall, who built a large number of the LEOPARD 2, has also developed an upgrade package for this vehicle which was originally called MBT REVOLUTION but is today called the Tank Technology Testbed (TTB). This is based on a LEOPARD 2 hull and turret but draws in Rheinmetall's extensive experience in AFV sub-systems such as a new commander and gunner stabilised day/thermal sights, cameras for enhanced situational awareness through 360 degrees, roof mounted RWS, new grenade launchers, enhanced passive armour and an active protection system (APS) to name but a few. The 120mm L44 smooth-bore gun is retained but can be modified to fire the latest Rheinmetall DM11 ABM round.

Rheinmetall has exported 103 surplus LEOPARD 2 MBTs to Indonesia of which 61 were upgraded to the LEOPARD 2 RI



Photo: Christopher F Foss

**The Turkish Land Forces Command has ordered the ALTAY MBT which was developed by Otokar, but the production contract was awarded to BMC.**

(Republic of Indonesia) standard which included installation of a new all electric gun control equipment (GCE), auxiliary power unit (APU), air conditioning system, additional protection and rear view camera. Rheinmetall also won the contract to upgrade 128 LEOPARD 2A4 MBT for Poland which also incorporate elements of the Rheinmetall TTB with first vehicles upgraded in Germany with the remainder being upgraded in Poland. Rheinmetall are also working on new turrets armed with their 130mm smooth-bore gun which could be of the conventional type or remote controlled.

Following a competition, RBSL, a joint venture company between Rheinmetall and BAE Systems, were in May 2021 awarded a €770M contract to upgrade 148 of the British Army's CHALLENGER 2 MBTs to the enhanced CHALLENGER 3 standard. This work will be carried out at Telford and includes a brand new turret armed with the latest Rheinmetall 120mm L55A1 smooth-bore gun coupled to a computerised FCS and Thales commanders and gunners stabilised day/thermal sights incorporating an eye-safe laser rangefinder. Vickers Defence Systems built a total of 386 CHALLENGER 2 at their Newcastle-upon-Tyne and Leeds

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**MERKAVA MBT of the Israel Defense Force fitted with Rafael TROPHY hard kill active defence system**

facilities, but the fleet has already been reduced to 227 units.

The Italian company of Leonardo has developed an upgrade package for the M60 MBT which they manufactured under licence many years ago for the Italian Army. This has a host of improvements including a new computerised FCS, new commanders and gunners sights, upgraded power pack, replacement of the 105mm rifled gun by a 120mm smooth-bore gun, additional passive armour and a roof mounted RWS for close in protection.

While not a member of NATO, Israel has extensive experience in upgrading SHERMAN, M48 and M60 MBTs as well as developing the unique and combat proven MERKAVA MBT which has been constantly upgraded over the years. The latest versions of the MERKAVA have the combat proven RAFAEL TROPHY APS which is now fitted onto some of the US Army M1A2 ABRAMS deployed to Europe and will be fitted to some German Army LEOPARD 2 A7A1 MBTs and British Army CHALLENGER 3 MBTs. Israel also has success in upgrading other countries MBTs with a good example being the upgrade of

170 M60A3 to the M60T standard for Turkey. Prime contractor for this was Israel Military Industries, since taken over by Elbit with most of the upgrade work being carried out in the facilities of the TLFC who have extensive experience in the overhaul and upgrade of MBTs as well as other AFVs. Elbit has also upgraded T-72M1 MBTs in the key area of FCS.

The Turkish M60T upgrade was extensive and included a new 120mm smooth-bore gun, new power pack, new sighting and FCS, upgraded suspension and new protection package which includes ERA which was first installed on upgraded CENTURION and M60 MBTs of the IDF.

## Support Vehicles

In order to maintain their battlefield manoeuvrability on the complex battlefield, MBTs need a number of key support vehicles including armoured recovery vehicles (ARV), armoured vehicle launched bridges (AVLB) and combat engineer vehicles (CEV). The ideal solution is that these should be based on an MBT platform with the same level of armour and mobility and that they should be introduced at the same time, but this is usually not the case.

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The French Army took delivery of only 20 LECLERC ARV which have a stretched chassis, new superstructure and the same German MTU EuroPowerPack as installed in the LECLERC MBT supplied to the United Arab Emirates. The French Army has not deployed a tracked AVLB to support its LECLERC MBT but deploys the French CNIM Modular Assault Bridge system which is transported and launched from a 10x10 platform with a protected forward control cab. Today, the standard French Army CEV is based on a modified AMX-30 but in the longer term, this will be replaced by a new wheeled CEV which is currently called the Moya d'Appui au Contact (MACV) and for which there will be a competition.

Apart from the LECLERC MBT and ARV and some older AMX-30 based specialised vehicles, the French Army has moved to a total wheeled solution for its fleet of AFV as they have greater strategic mobility than their tracked counterparts and have lower life cycle costs.

The German Army took delivery of its first LEOPARD 2 MBTs as far back as 1974 followed by the BUFFEL ARV in 1991, with the initial production run being for 100 units – 75 for Germany and 25 for the Netherlands. Since then, additional countries have ordered the BUFFEL ARV. Only 36 LEOPARD 1 based AEV were supplied to the Germany Army; they are called Pionierpanzer 1 DACHS. These were followed converting 104 LEOPARD 1 ARV and the original 36 DACHS to a new build standard called Pionierpanzer 2 DACHS. These do not have the protection and mobility to operate with the LEOPARD 2 and in April 2021, a contract valued at €295M was placed with Rheinmetall covering the supply of 44 Pionierpanzer 3 DACHS, with delivery to run from 2023 through to 2029. This was originally developed by Rheinmetall and RUAG as a private venture as the KODIAK. This is already deployed by Singapore, Switzerland, Sweden and the Netherlands.

The current German Army BIBER AVLB is based on the LEOPARD 1 platform but this will be replaced by the LEGUAN based on a LEOPARD 2 chassis with

the German Army ordering 24 units for delivery between 2023 and 2018. Prior to this, Krauss-Maffei Wegman had already won export LEOPARD 2 LEGUAN AVLB orders from a number of other countries including Singapore, Switzerland and Sweden.

The UK is one of the few countries to have a common MBT fleet which comprises the CHALLENGER 2 MBT, CHALLENGER Armoured Repair and Recovery Vehicle, TITAN AVLB, TROJAN AEV and some driver training vehicles.

For many years, the standard ARV of the US Army was the M88A1 which could not recover the latest ABRAMS MBTs. Further development resulted in the much improved M88A2 which can safely recover the latest ABRAMS M1A2 MBT. The US Army phased out the M728 CEV based on the M60 MBT without an immediate replacement.

Using surplus M1 ABRAMS hulls, the Assault Breacher Vehicle (ABV) was developed with the first customer being the US Marine Corps followed by the US Army with Pearson Engineering providing the front-end equipment. ■



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# Long-Range Observation Systems

**Tamir Eshel**

Government and military authorities have always valued intelligence as a critical asset for decision-making and for its ability to respond to developments at the strategic or tactical level. Being informed and pre-warned, authorities can plan, assess, prepare, and respond to unfolding events in order to shape the outcome of events in their favour.

In the modern era, intelligence comes in many forms, utilising different information-gathering techniques. Still, the oldest and most common is visual intelligence (VISINT), obtained by the sight of an individual human observer or through various optical or electronic sensors able to enhance human vision.

Typical surveillance and reconnaissance systems are designed to extend human visibility using optical or electronic (Electro-Optics - E.O.) means, various night vision devices and thermal sensors operating in the swaths of the infrared (IR) waveband to enable a human to see during the day and at night. Thermal imaging differentiates targets from their surroundings by highlighting the differences between ambient temperature and the target's specific temperature. In order to see further, EO/IR systems use powerful optics designed for each sensor to extend the distance they cover, enabling the observer to see, recognise and detect objects and targets from great distances.

## How Long is Long-Range?

Long-range is a relative term that depends on the mission requirement and user needs. For a sniper, long-range may mean 1,500 m. For a ship at sea, long-range extends to the horizon at about 20 km, while a drone flying at height can see as far as 50 km but is limited by the sensor's size and weight. A strategic airborne reconnaissance mission is often required to bring aerial reconnaissance from a standoff range of 50-100 km using specially designed long-range optics, while satellites orbiting in space use powerful telescopes to deliver sharp and detailed images from hundreds of kilometres. Therefore, the longer the observation is required, the higher the resolution and larger the sensor are, coupled with heavier and bulkier optical systems. Different applications often use unique designs and bespoke optical systems, lenses, optical assemblies, and stabilisation systems to meet

Photo: CONTROP



**Controp offers the SPEED family of sensors for border protection and critical infrastructure security.**

user requirements and specified system size and weight.

But there are also similarities. The longer the range the sensor covers, the narrower its field of view is. Therefore, aiming and tracking become an issue, often addressed with various levels of automation and teamwork. Most VISINT observations are limited by weather conditions, including clouds, rain, fog, or dust, which hamper visibility, especially at long distances. A combination of filters and sensors may alleviate these limitations to some degree.

Below are some of the latest solutions for long-range observation offered by E.O. specialist manufacturers.

## Silent Sentinel

When integrated with border protection networks, long-range observations help cover certain areas in complex or inaccessible terrain. In the coastal surveillance role, it can also help detect and identify targets at sea. Silent Sentinel, which offers the JAEGER family surveillance systems for such missions, has committed four variants

to perform long-range surveillance. These four systems include the RANGER, RANGER LR, SEARCHER, and JAEGER ULR; all combine thermal (Long Wave IR – LWIR) and HD video cameras mounted on a pan-tilt pedestal. The RANGER detects a human target at nearly 5 km distance, with the LR extending the range to 12 km, the SEARCHER up to 24 km, and the ULR offers human detection at 30 km with vehicle detection up to 50 km.

## Infinity E.O.

When users need to improve night surveillance, illumination is one of the options to enhance sensor performance. For this purpose, Infinity Electro-Optics offers the Zoom Laser IR Diode (ZLID) that illuminates the scene for camera sensors but is invisible to the human. Unlike common IR LED illuminators that are effective only a few hundred metres away, ZLID is effective up to a distance of 5,000 m. ZLID adjusts the laser's intensity and focus area using a motorised lens, eliminating the overexposure, washout, and hotspots that usually occur with lasers. Although ZLID is



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Photo: IAI



**IAI's MegaPOP is designed for security and surveillance of coastal and land borders.**

effective for identification and recognition since it is an active emitter, it may alert the target under investigation.

### Elbit Systems of America

The US Customs and Border Protection Agency (CBP) will soon be able to evaluate an Autonomous Relocatable Surveillance system that uses a 33-m tower, carrying a ground surveillance radar, a high-resolution day camera, a thermal camera, and a laser illuminator operated in synch to cover bor-

der areas of increased activity or with land use and environmental concerns. This trailer-based tower can be quickly deployed to places of interest and set up by users in less than two hours. The system uses artificial intelligence/computer vision to automatically maintain situational awareness by autonomously detecting, tracking, and identifying items of interest and then sending the information to command-and-control centres with no operator intervention. This increased automation and autonomy reduce operator workload to the point where fewer agents are needed to observe larger sections of the border.

### Hensoldt

When the surveillance range extends further, specialised multi-sensor systems are used. Hensoldt's NIGHTOWL ZM-ER is optimised for long-range performance by combining a thermal MWIR imager with x11 continuous optical and x8 digital zoom, a daylight camera with x30 optical and x8 digital, and a laser range-finder. The ZM-ER can detect human targets at >21 km and vehicles at >24km. The recognition range is reduced to >8 for humans and >14 for vehicles, while identification can be made at 4 km and 9 km, respectively.

### Controp

Controp has offered the SPEED family of sensors for border protection and criti-

cal infrastructure security. The company has recently added a long-range member to the SPEED family, addressing market demands for surveillance at long ranges. The fully digital and stabilised multi-spectral SPEED-LR system significantly increases surveillance capabilities, particularly when rapidly detecting and identifying potential threats from increased distances. The SPEED-LR incorporates a high definition (HD) cooled mid-wave infrared (MWIR) sensor and HD day camera, as well as a short wave infrared (SWIR) camera. The latter sensor allows users to effectively see obscurants such as mist, humidity, fog, dust, or smoke. A line-of-sight stabilisation ensures a sharp image for operators, even at the narrowest field of view, even when fully zoomed in.

### IAI

Israel Aerospace Industries (IAI) has also expanded its family of electro-optical/IR payloads with the introduction of the MegaPOP, designed for security and surveillance of coastal and land borders. MegaPOP combines an HD thermal, a colour daylight HD video, and HD SWIR channels, all using continuous high-power zoom to deliver high-quality output even in limited visibility. Aerodynamic shaping allows the MegaPOP to withstand high wind loads and base vibrations, while the gyro stabilising system maintains a stable image. The system also uses an accurate, magnetic-independent, northing capability to assist in managing target datum points. The multi-spectral capability enables observation, detection, recognition, and identification at exceptionally long ranges. Digital tracking and surveillance automation capabilities are among the advanced features that enable optimising mission performance with reduced operators. When integrated with other detection means, the MegaPOP can act as the primary detecting sensor or a secondary "spotter", using digital interfaces that combine active or passive sensors, such as radar, ELINT, and COMINT.

### L3Harris

Unlike the land-based observation systems that are often static, mobile and airborne systems are tailored to meet the platform designer's stringent specifications for mission payloads. They must meet weight, size, and power requirements that often limit the performance of standard systems and may call for bespoke solutions for long-range operations.

The Model 2111X or 2511 from L3Harris was designed for such missions. It combines a shared aperture for up to six sensors



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mounted low in the turret for an optimised field of regard and minimised penetration into the airstream. Sensors include the HD MWIR and NIR coupled with 11-inch multi-spectral telescope zoom lenses covering the wide, medium, and narrow field of view. HD videos also come with matching zoom covering wide, medium, and narrow to super-narrow fields. Other devices may also include different lasers for range-finding, designation, or marking. The system uses a navigation-grade Inertial Measurement Unit (IMU) and global positioning system receiver to perform precision geolocation and geopointing. Among the applications these payloads were used for include route surveillance and Counter-Improvised Explosive Device C-IED, employing road-following mosaic imaging and change detection techniques, comparing high-resolution image mosaics collected along long and curving roads in high threat areas.

For the next generation European Medium Altitude Long Endurance Remotely Piloted Aircraft System (MALE RPAS), Safran, Hensoldt, and Mades are developing an ultra-long-range E.O. system called EUROFLIR 610 that integrates up to 12 electro-optical considered necessary for the mission. The new system will be based on Safran's EUROFLIR 410 New Generation, which, in itself, integrates up to ten sensors. The company stated that the EUROFLIR 610 observation and targeting system's high-performance line-of-sight stabilisation would enable ultra-long-range capability and high-precision target geolocation.

## Ball Aerospace

The US Navy is currently equipping some of its surface ships with the I-STALKER



Photo: Silent Sentinel

**SILENT SENTINEL combines thermal (Long Wave IR – LWIR) and HD video cameras mounted on a pan-tilt pedestal to detect humans at very long ranges.**

Long Range Electro-Optic Sensor System (LREOSS) installed on two NIMITZ class nuclear-powered aircraft carriers (CVNs). The I-STALKER evolved from the LREOSS prototype developed by Ball Aerospace which addressed the fleet counter-swarm urgent operational need in 2010. The new I-STALKER replaces the first generation LREOSS system, which initially used the NATO SEASPARROW Missile System (NSSMS) M.K. 6 Low Light Level Television (LLTV) for its primary sensor.

## Image Processing, AI

Even with the best optics and sensors, images tend to degrade when observed at long range. While a single channel is more affected by this degradation, the fusion of images collected over several multi-spectral channels yields a better picture, more comprehended by the human eye. Modern systems use multi-sensor assemblies that include 10 or 12 optical and IR systems in one platform and offer different image fusion and detail extraction levels to enhance mission performance.

This capability can be performed by 'Edge Computing', with deep learning (AI) processing integrated into the camera itself – as already offered by the Teledyne FLIR, or by special video processing units (VPU) systems L3Harris delivers with its payloads. These are powerful supercomputers crunching the digital images captured by standard cameras. Both methods provide images with rich metadata that the human senses do not use but can help automated artificial intelligence recognise or automatically track valuable targets.

Sharp-eyed observers and telescopes are no longer the foundation of intelligence, surveillance, and reconnaissance. Modern electronic and optical systems have improved those capabilities by increasing the detection, identification, and recognition capability while reducing the size and weight of the surveillance systems. Edge computing, advanced neural networking, and AI represent the next evolutionary step for those systems which will continue to evolve, offering users ever more sophisticated and cutting-edge performance that surpasses human cognition and senses. ■

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# European Frigate Programmes Gain Momentum

**Luca Peruzzi**

**The increasing global crisis related to maritime sovereignty and resource exploitation has forced European countries to beef up their fleets with new frigate procurement programmes.**

This trend is supporting the national and transnational shipbuilding and naval industry, both within Europe and world-wide, where customers want to develop their own naval and defence capabilities through local shipbuilding and industry involvement with partnerships, technology transfer and support solutions.

## France

The delivery of the last AQUITAINE class frigate in 2022, the French side of the joint Italian-French FREMM (Frégate européenne multi-mission-European multi-purpose frigate) programme is leaving space at Naval Group and French naval industry facilities to the new Frégate de défense et d'intervention (FDI) or BELHARRA multi-role intermediate-size frigate shipbuilding programme. At the same time, France is continuing to invest in enhancing the current classes of AQUITAINE and LA FAYETTE class platforms to satisfy the Defence Planning Law (Loi de Programmation Militaire) 2019-2025 requirements for a fleet of 15 first-rank frigates by 2030. After the French DGA contract award in April 2017 to Naval Group (as prime contractor and combat system integrator) and Thales for the first-of-class ADMIRAL RONARC'H FDI, the shipbuilding programme saw an acceleration last April with a shipbuilding contract award for the second and third FDI to be delivered in 2025. MBDA, which is responsible for the new generation missile firing system development and ASTER 30/EXOCET BLOCK 3/3c delivery, is part of the awarded contracts. Although the first-of-class frigate delivery is postponed to 2024 due to the pandemic, the third frigate hand-over to the Marine Nationale is anticipated by one year to cope with service operational needs but also any request coming from the export market. With a 4,500 t displacement and a 125 member crew, the multi-purpose FDI is the first digital native platform and combat system equipped platform for the French Navy, featuring the Thales-provided four fixed faces (4 FF) fully-digital AESA

Photo: Marine Nationale



**The French Navy FREMM frigate, ALSACE**

Sea Fire multi-function radar and newest MBDA universal missile firing system capable to accommodate the present and future surface-to-air and surface-to-surface weapon systems. The new frigate also features a Thales ASW suite with hull-mounted and towed array sonars together with a flight deck and hangar for an NH90 helicopter and the future 700 kg vertical take-off and landing (VTOL) unmanned platform being developed by Airbus Helicopters, Naval Group and French industry. The first of five LA FAYETTE class frigates under modernisation by Naval Group returned to sea last March while the French industry is continuing to enhance the AQUITAINE class units, introducing the two FREMM DA (Défense Aérienne) with expanded AAW capabilities. In parallel, new technologies and systems are being tested and applied, such as the Veille Coopérative Navale (VCN), the French real-time fusion and distribution suite for engaging tracked aerial threats, already demonstrated on board the AQUITAINE class frigate and other fleet platforms to be deployed by 2022.

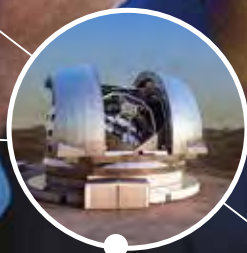
## Germany

Last June, the German Parliament's budget committee approved the financing of 27 main defence procurement and upgrade programmes. In addition to new U212CD submarines, in partnership with the Norwegian MoD, and Class 424 replenishment vessels, the committee also approved the mid-life upgrade for the F-123 frigates, which was contracted a month later and also the long-range radar replacement for the F-124 platforms. The contract award for the latter programmes represent the latest milestones in the revamping of the German Navy's frigate component, notably with the delivery of the F-125 BADEN-WÜRTTEMBERG class vessels and their entry into service. This revamping also extends to the new F-126 class shipbuilding programme, and the next phase of the still to be defined F-127 class platforms. With the delivery of the fourth and final F-125 frigate later this year by the ARGE F125 consortium between thyssenkrupp Marine Systems (tkMS) and Fr. Lürssen shipyard, the troubled and pandemic-hit shipbuilding



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Photo: Naval Group



**The Naval Group FDI frigate with SDI programme unmanned aerial vehicle**

and delivery programme will come to an end. The F125 frigates have been designed to conduct expeditionary and stabilisation missions, remaining deployed for a period of up to two years in distant theatres of operations. With a 7,100 t displacement, the F-125 frigates feature a combat system based on the Atlas Elektronik command management system (CMS) and include the Hensoldt 4FF AESA multi-function radar, a Leonardo 127/64 mm LW gun to be equipped with VULCANO long-range guided ammunitions to support land operations alongside two RAM-System RAM inner-layer defence systems with Block 1/2 RAM missiles. Four fast RHIBs for special forces and a flight deck with hangar to accommodate two NH90 helicopters are also included. With the contract award to the Dutch Damen shipbuilding group as the main contractor, in cooperation with the German Lürssen shipyard and Thales Deutschland (mission system responsible) in June 2020, the F-126 frigate design restores a full fighting capability warship to the German Navy characterised by mission modularity aimed at accomplishing a wide range of missions, including in polar regions, with a multi-crew concept and

a robust combat system. With a 10,000 t displacement, the F-126 will be able to accommodate a mission module in addition to two (plus one) boats and a flight detachment with two NH90 helicopters and one VTOL Saab SKELDAR V200 UAS. The combat system will include the Thales TACTICOS Block 2 CMS managing a sensors suite with Hensoldt TRS-4D NR 4FF AESA radar, Thales APAR Block 2 radar, Gatekeeper distributed IRST, two MIRA-DOR Mk2 FCS, MSSR 2000I/LTR 400 IFF and Rohde & Schwarz KORA 40 RESM/CESM. The armament will include VLSs for ESSM Block 2 and GMLS RAM Block 2B, Kongsberg NSM Block 1 surface-to-surface missiles and a gun package including the Leonardo 127/64 LW and 12,7 mm remote weapon systems (RCWS) alongside Rheinmetall's LMG 27 mm RCWS. First ship keel laying is planned for early 2024 with deliveries set for 2028, 2030, 2031 (two ships) and options for two additional ships in the 2032-2033 period. Last July, Saab announced it had signed a contract with the German MoD for the modernisation of the BRANDENBURG class (F-123) frigate. The contract includes delivery and integration of Saab's 9LV CMS, SEA GIRAFFE 4A and

SEA GIRAFFE 1X radars, CEROS 200 FCS and third party systems, including IFF capability, alongside a comprehensive, performance-based logistics package. Deliveries and other services will take place between 2021 and 2030.

## Greece

The Greek Ministry of Defence is evaluating the proposals submitted by international contenders to satisfy the Hellenic Navy's requirements for the procurement of four new frigates. These are to be built locally in order to re-capitalise Greek shipyards and defence industry involvement, in addition to a 'stop-gap' solution with two second-hand (or new platforms as proposed by some contenders), and the mid-life update of four in-service HYDRA-class MEKO 200HN frigates. Proposals with respective Government support, either being considered or submitted for procurement, include Babcock International, Damen, Fincantieri, Lockheed Martin, Naval Group, Navantia and tkMS with, respectively, the ARROW-HEAD/Type 31, SIGMA 11515, FREMM ASW, Multi-Mission Surface Combatant (MMSC)-based HF2, FDI/BELHARRA, F-110 and MEKO A200 NG (or MEKO A300) platform designs. Some of the contenders with respective Government support, offer a 'stop gap' solution based on second-hand platforms as with Babcock International (Type 23), Damen (M-frigate), Fincantieri and Lockheed Martin, while others offer new ships like Naval Group (FDI) and Navantia (Alfa 3000), or even both solutions like Damen (SIGMA 10514). The Greek Government is expected to make a decision after the summer period, but most likely by year's-end.

## International

The joint Netherlands/Belgium M-frigate replacement (Vervanging M-fregatten – vMFF) programme to procure four new frigates to substitute the two navies' in-service M-frigates has entered the procurement preparation phase with the aim to sign a contract by the end of 2021. This will be followed by a detailed design phase, which will require approximately two years, more than initially planned. As a result, the delivery of the first-of-class ship was postponed from 2025 to 2027. The MoD-led integration and test activities will lead to the ship handover to the Royal Netherlands Navy in 2028 followed by the second in 2029. The two Belgian Navy frigates are to be delivered by 2030. The previous programme phases weighing requirements, budget and planning, has so far led to a platform design to

Photo: Bundeswehr



**A German Navy F-125**



include a length of 133 m and displacement of circa 5,500 t, characterised by a 110 core crew complement and additional accommodation for 40 mission-specific personnel. The ship will be equipped with a full ASW suite, including hull-mounted and towed sonars, Mk 54 lightweight torpedoes, and an NH90 helicopter. The new frigate will also have a robust surface warfare capability centred on the new Above Water Warfare System (AWWS) under development by Thales Netherlands together with EW and panoramic electro-optical suites. The AWWS combines a dual-band (X/S-band) radar suite with an integrated fire-control suite capable of managing the Raytheon ESSM Block 2B local area missile system, to be launched by a 16-cell VLS for a total of 64 effectors. The ship will be armed with a Leonardo 76/62 medium-calibre gun (images show the 'Single Deck' version) selected for its provision of DART guided ammunitions with Thales Nederland PHAROS FCS, in addition to larger and smaller calibre RCWS, with images showing the Leonardo OTO Marlin 40 mm mount and Thales Nederland MIRADOR Mk2. Other equipment includes a new maritime surface-to-surface missile system to replace the current HARPOON under a separate procurement project. Growth potential includes Direct Energy Weapons (DEWs) and provision for unmanned system operations and support.

## Italy

Last February, Fincantieri shipbuilding group celebrated the first steel cut for the first of two new FREMM frigates destined for the Italian Navy. These new BERGAMINI class platforms in the General Purpose (GP) configuration will replace the two same variant FREMMs, previously ordered and built for the Italian Navy but later sold to Egypt to enter into service with the Egyptian Navy in December 2020 and April 2021 respectively. Fincantieri will also provide the Italian Navy a support package to extend the service life of the remaining MAESTRALE class frigates until the two new platforms will be delivered in February and August 2025 respectively. With Orizzonte Sistemi Navali (OSN) as the Italian industrial prime contractor, the procurement programme for two additional ships comes under the OCCAR agency as part of the joint French/Italian FREMM programme, increasing the overall number of platforms to 22, including foreign customers. The new FREMMs will feature limited configuration modifications and enhancements, leveraging on the developments and technologies introduced



Photo: Damen Schelde Naval Shipbuilding

**Rendering of an MKS 180 - F126**



Photo: Saab

**Computer image of the F-123 modernised by Saab**



**The Netherlands MOD concept (artist's impression) of the new Dutch-Belgian frigates**

Photo: Dutch DMO

with the Italian Navy's new generation platforms, to cope with obsolescence and a minimum 25 year operational lifespan. In addition to Egypt, Italy's FREMM design found international success after being selected by the US Navy for the FFG 62 CONSTELLATION programme and more

recently by the Indonesian Navy for a new class of six units to be partially built locally with a technology transfer and support package by PT-PAL shipbuilder. Although not classified as frigates, the Italian Navy's THAON di REVEL class of the Pattugliatore Polivalenti d'Altura (PPAs)

platform have dimensions and a combat system compatible with the former warships. Intended to replace a range of vessels (destroyers, frigates and patrol ships) with a multi-purpose patrol vessel developed with a 'one size fits all' concept in mind, the PPAs come in three different configurations, from 'PPA Light' to perform low-intensity operations to the 'PPA Full' capable platforms for high-end operations. The first-of-class PAOLO THAON di REVEL (PPA Light) is expected to be delivered by Fincantieri as prime contractor and Leonardo as combat system integrator and supplier, in the last quarter of 2021, with a few months delay due to the pandemic. The second PPA (PPA Light) is planned to be delivered in the first quarter 2022, while the third (PPA Light Plus) and fourth (PPA Full) are being launched this year to be handed over in the first quarter 2023 and second quarter 2024 respectively. All seven vessels are expected to be delivered by 2026. With a full load displacement of 6,350 tonnes (PPA Full configuration) and a 143 m length, the Full combat capable PPA configuration (to be delivered in two ships) features an advanced platform conducting and combat station, Leonardo's new generation CMS and dual-band (C and X) 4 fixed faces each (4FF) AESA dual-band radar (DBR) and distributed IRST, Elettronica RESM/CESM/RECM suite together with MBDA Italia evolved SAAM-ESD (Surface Anti-Air Missile-Extended Self-Defence) based with 16 cell VLSs for the ASTER family missiles, capable also of handling ballistic missile threats, alongside Leonardo's 127 mm LW VULCANO and 76/62 Single-Deck gun and two 25 mm RCWSs.

## Poland

In July 2021, the Polish MoD's Armament Inspectorate and the PGZ-Miecznik consor-



**The FREMM GP ITS LUIGI RIZZO**

tium led by the PGZ group signed an agreement for the so-called 'Miecznik' procurement programme for three new frigates. The consortium also includes the PGZ SW shipbuilding facility and the Remontowa Holding shipbuilding group. The new frigates will be based on a foreign customised design with a technology transfer programme, for which three international contenders have been shortlisted: Babcock, Navantia and tKMS. The winning foreign partner is to be selected between late 2021 and early 2022 with a design and shipbuilding programme aimed at a first frigate launch by the Polish consortium in four years' time.

## Spain

With the Spanish MoD's contract award to Navantia shipbuilding group in April 2019, followed by parliamentary approval of the initial funding release in November 2000, the Spanish Navy's F110 frigate programme for the design and construction of five new multi-purpose combatant platforms, successfully reached the Critical Design Review (CDR) phase last May. This will lead to the first steel cut for the leading platform in the first half of 2022 and a planned launch around the end of 2024, for a commissioning into service at the beginning of 2027. The remaining frigates will follow by 2031. Ca-

pable of operating in high-to-low intensity warfare scenarios in blue and littoral waters, the 6,170 t displacement and 145 m long frigate is characterised by a multi-mission, flexible bay alongside the hangar, the latter capable of accommodating one SH-60B/NH90 helicopter, in addition to unmanned VTOL platforms. Developed by Indra as prime contractor and main provider, the F-110 combat system is based on an evolved SCOMBA CMS, with integration between AAW weapons and sensors suite through the so-called US International Aegis Fire Control Loop. The integrated mast includes a new 4FF AESA radar being developed by Indra with US Lockheed Martin, Indra's PRISMA 25X AESA multi-function surface radar, Indra/Tecnobit panoramic IRST, new generation communications, data link and identification package, EW suite with RESM/CESM/RECM, and a new DORNA FCS, all developed by Indra, in addition to two illuminators for Raytheon STANDARD 2 AAW missiles. The Thales ASW package includes the BlueMaster (UMS 4110) bow-mounted sonar and CAPTAS 4 Compact VDS, in addition to the BlueScan digital acoustic suite. The weapons package includes Raytheon STANDARD and ESSM Block 2 missiles, finding accommodation in a 16 cell Mk41 VLS, while ASuW armament include launchers for eight anti-ship missiles. The gun package features a Leonardo 127/64 mm LW VULCANO main gun, two 30 mm and four 12.7 mm RCWSs, in addition to lightweight torpedo launchers and provisions for DEW.

## Turkey

In January 2021, the first I-class (ISTIF class) frigate was launched at Istanbul Naval Shipyard. Under a contract awarded in September 2019, the Turkish industrial team led by STM as prime contractor will delivery four frigates between 2023 and 2027. Based on the ADA class corvette design which found export success in Pakistan, the new class of frigates has a larger national systems content. With a 3,000 t displacement and 113.2 m length, the



**The Italian Navy's first-of-class ITS THAON DI REVEL PPA**



I-class platform features a more efficient propulsion system and combat suite based on the Havelan ADVENT CMS. The latter manages a national sensor suite including Aselsan HAZAR 3D AESA radar, Aselsan ARES-2N/AREAS-2N RESM/RECM, AKREP fire control radar, PIRI IRST, Aselsan FER-SAH hull-mounted and HIZIR torpedo defence system. The armament package includes locally-developed 16-cell VLS and air-defence missiles, 35 mm GÖK-DENİZ inner-layer defence system, Roketsan ATMACA Block 1 anti-ship missiles in addition to a Leonardo or MKEK 76/62 mm gun and Aselsan 25 mm RCWSs. In parallel, the Turkish MoD launched the Mid-Life Upgrade programme for the Barbaros (MEKO 200TN) class frigates in 2018 which relates to the integration by Aselsan/Havelan of latest generation nationally-developed systems, with the upgrade to be completed in the 2022-2024 period.

## UK

With a contract awarded to BAE Systems in June 2017 for the first batch of three frigates, the UK MoD's Type 26 programme is today at an advanced ship-building stage with all three ships under construction since last June. Designed to meet requirements for a globally deployable and multi-mission warship, the Type 26 class includes eight ASW-oriented frigates, of which the first-of-class is planned to enter service in 2026, twelve months sooner than forecast at the contract award time. The BAE Systems' Type 26 Global Combat Ship (GCS) digital design found worldwide success among the 'five eyes' countries, having been contracted in customised versions also by Australia and Canada. With an 8,000 t full load displacement and a length of 149.9 m, the Type 26 design features a flexible mission bay located amidships and a large flight deck and hangar for two Leonardo WILCAT helicopters. The BAE Systems CMS with shared network infrastructure and environment manages a sensors and weapons suite including BAE Systems ARTISAN 997 medium range radar, Thales UK UAT MOD 2 family RESM, and an ASW suite with Ultra Electronics Type 2150 bow-mounted and Thales Sonar 2087 variable depth sonars. The missile package features two 24-cell VLSs for the MBDA SEA CEPTOR air-defence missiles and 24-cell strike-length Lockheed Martin Mk41 VLS to accommodate the MBDA Future Cruise/Anti-Ship Weapon (FCASW) from 2028; BAE Systems Mk45 Mod 4 5-inch/127 mm main gun, two Raytheon PHALANX



Photo: Navantia

**The F110 multi-role frigate**



Photo: BAE Systems

**BAE systems' Type 26 frigate**



Photo: Rolls-Royce

**Babcock International's Type 31 lightweight frigate**

1B, two MSI-Defence Systems SEAHAWK DS30M Mark2 30 mm, and provisions for DEW growth.

The balance of the Royal Navy's frigate component is satisfied by the Type 31 programme for a fleet of five lighter, cheaper, and readily exportable general purpose frigates, for which the contract was awarded in November 2019 to the Babcock International-led industrial team including Thales, OMT, BMT and Frazer-Nash. The UK Government announced in late 2020 the future procurement of a new class of more flexible Type 32 frigates. Based on the Danish Navy's IVER HUITFELDT class proven platform, the Type 31/ARROWHEAD 140 design passed the Whole Ship Critical Design

Review (WSCDR) last April, for a first-of-class platform entering service in 2027. With a 6,000+ t displacement and a 138.7 m length, the INSPIRATION-class frigate combat system is centred around the Thales TACTICOS CMS, with communication suite and a sensors package including Thales NS100 AESA radar, Thales GATEKEEPER non-rotating EO cameras, two Thales MIRADOR MK2 EO FCSS, Thales VIGILE-D RESM and decoy launchers. The armament includes a BAE Systems BOFORS 57 mm Mk3 main gun, a 12-cells VLS for MBDA SEA CEPTOR SAMs, two BAE Systems BOFORS 40 mm Mk4 guns, machine guns, space and provisions for anti-ship missiles and additional air-defence VLSs. ■

# A New Frigate for the Hellenic Navy

**Stephen Barnard**

The Hellenic Navy's (HN) new frigate will be a "high end" multipurpose/multimission frigate with advanced capabilities in anti-air, anti-submarine, and anti-ship warfare. These frigates will ensure the navy's core, traditional war-fighting capabilities remain effective for the next 15 – 20 years.

## Background

The Greek coastline is around 15,000km, including 227 islands. To the west, Italy; Turkey to the east. Albania, North Macedonia and Bulgaria to the landlocked north: to the north-east a 200km / 120mile land frontier with Turkey. On the three remaining sides are the Adriatic, Ionian, Mediterranean and Aegean seas. Greece shares a Joint Defence doctrine

## Missions and Assets

Generally, the mission of the HN is to deal with any external threats and provide patrol support to the Hellenic Coast Guard (for which latter task a corvette may be a suitable, smaller platform.) Theoretically, heavy corvettes could be procured to replace the four ELLI-class ships not updated in the 2004-2009 MLU programme. The HN is thought likely to acquire modified

in 2013) will be replaced under the new frigate programme.

## Regional Security and Challenges

Since 2016 the EU, with additional funding from member nations, has paid Turkey to host the Turkish Facility for Refugees, which currently accommodates some four million people. That programme is funded until 2021-2025, also at €1Bn annually. In early 2020 the Turkish government unilaterally opened its border with Greece, and the influx of refugees by land and sea began again. Maritime boundaries in the eastern Mediterranean have long been in dispute, particularly over energy resources. The situation was inflamed in early 2021, when Turkish Navy warships opened fire on HN coastguard vessels: it is necessary for the HN to be able to discourage similar actions in the future.

## HN Shortlist

In alphabetical order the shortlisted shipyards are:

- Babcock (UK) with the Type 31/ARROWHEAD (approx. 6,000 tons displacement)
- Damen (Netherlands) with the SIGMA 11515 (displacement approx. 4,400 tons)
- Fincantieri (Italy - allegedly with the FREMM) (displacement approx. 6,000 tons)
- Lockheed Martin (USA) with the FREEDOM-class MMSC (LCS) (displacement approx. 3,500 tons)
- Naval Group (France) with the FDI/BELHARRA (approx. 4,400 tons displacement)
- tkms (Germany) with the MEKO A200NG (or MEKO A300) (approx. 5,500 tons in Polish Navy configuration – the MEKO 200HN displaced around 3,400 tons)

## Early Days

The acquisition of up to four Naval Group FDI BELHARRA-class frigates from France, with high-end AAW and Deep Missile Strike capabilities was put on hold in July 2020, reportedly due to the cost - almost



Photo: Babcock International

**Babcock's ARROWHEAD 140 has been short-listed by the HN.**

with Cyprus. The Hellenic maritime capability requirement is significant. On 5 June 2021 Prime Minister Kyriakos Mitsotakis announced the intention to acquire four heavy frigates, alongside an MLU for the existing HYDRA-class frigates.

## Author

**Stephen Barnard** is Publisher of EUROPEAN SECURITY & DEFENCE. Additional comments by William Nilly, a dedicated navel-gazer.

(larger) Israeli SA'AR 72 corvettes from Israeli Shipyards and their Greek partner, ONEX Neorion Shipyards - the THEMISTOCLES-class - but these are 800-ton vessels outside the scope of this report.

Frigates are the main heavy ships of the HN. There are 13 in service: four HYDRA-class and nine ELLI-class. The HYDRA-class is a modified Blohm & Voss MEKO 200 design, subject of intermittent upgrades from 2007/2008 onwards, as funds permitted.

The lead ship of the ELLI class is now some 40 years old. Six of the ELLI-class were modernised in 2004-2009; the other four (including one decommissioned



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**Lockheed Martin HF2 variant of the LCS, proposed to the HN.**

€3Bn for only 2 units - the lack of local production opportunities in Greece, and the late proposed delivery of the first unit, in 2025 at the earliest.

The US proposed the acquisition of four Multi-Mission Surface Combatants (FREEDOM-class MMSCs) developed by Lockheed Martin. On November 6th 2020, the HN submitted its acquisition request for four MMSC frigates; part of a package including the HYDRA upgrades, "intermediate solution" ships, and participation of Hellenic Shipyards in the US FFG(X)-type frigate development. The FREEDOM-class is in full production for Saudi Arabia, and "tested and in-service" with the USN. But the class's appalling reliability record is reported to have resulted in the USN declining new deliveries between January and June 2021; a delay to full USN mission capability until "at least" 2023; and early decommissioning by the USN - in the case of the US\$300M-US\$350M USS LITTLE ROCK less than six years after commissioning.

Two types might replace the ELLI-class. One idea, to purchase heavy corvettes, has gained traction since Greece joined the EPC programme, but the EPC is only half the displacement of some "proper" contenders, and on closer examination can probably be dismissed. Even allowing for a cheaper, faster EPC build (unlikely in a multinational consortium), an earlier in-service date (probably not before 2027), and substantial offset / technology transfer / workshare (wishful thinking), the capability shortfall seems decisive.

tkms from Germany is offering the MEKO-A200, a new and advanced version of the MEKO-200HN, offering increased homogeneity to the fleet, especially after the upgrade of the ships already in service.

## The Contenders

All companies involved were invited to elaborate on their propositions for the HN Frigate Programme. Babcock International and Naval Group are presented alphabetically.

**BABCOCK INTERNATIONAL** claims that it is creating a "game-changing" approach to global shipbuilding to offer warship design, build and in-service support options to international navies through its ARROWHEAD 140 general purpose frigate. For Greece, supported by the UK Government, Babcock has developed a programme meeting all the HN's requirements, including a) a HYDRA-class upgrade, b) an interim frigate capability and c) four Babcock ARROWHEAD 140 frigates. (ARROWHEAD is the design chosen by the Royal Navy for the Type 31 programme.) The company offers a package of support and industrial strategy supporting the modernisation of key Greek shipyard facilities, with partnership offers to Greek industry to develop local workforces and transfer knowledge and technology across the wider domestic shipbuilding supply chain.

ARROWHEAD 140 is a proven, adaptable design based upon an in-service hull-form that has been tried and tested in real-world operational environments: a cost-effective,

high-value vessel designed for in-country build. Because the design is selected for the Royal Navy's next generation frigates it offers accurate known costs and significant economies of scale. According to Will Erith, Chief Executive Marine, "...The buildability of the ships ensures the effective transfer of a UK design to Greece for efficient manufacture and in-country assembly, while de-risking the build programme... We will work with Greek industry to utilise domestic supply chains, to modernise and equip facilities, upskill and grow local workforces and transfer knowledge and technology to support an in-country build that will stimulate economic growth and prosperity."

**Propulsion.** The platform can accommodate various propulsion solutions and is big enough to embark sufficient fuel for long-range, independent, global operations.

**Armaments.** The platform can be fitted with a range of high-end capabilities. Offensive and defensive systems for enhanced air defence, surface and sub-surface warfare, maritime interdiction, self-protection and engagement of long range land targets provide significant strategic, political and operational choice and operational confidence.

## Mission Systems

The RN ARROWHEAD 140 incorporates the TACTICOS™ CMS, with open architecture and computing environments to provide a scaleable, upgradeable mission / combat management capability.

## Aviation

The flight deck accommodates a wide range of naval aircraft and air systems. The hangar can berth an organic medium naval helicopter such as a MH-60 SEAHAWK, plus various unmanned air systems.

## Ammunition Handling

Dedicated facilities to store and prepare air-launched weapons, including ASW torpedoes and Anti-Surface missiles, are provided. The flight deck can launch and recover non-organic aircraft weighing up to 15 tons.

## Accommodation

ARROWHEAD 140 can operate with a Ship's Company of fewer than 100 people. It has dedicated accommodation for 180+ personnel, plus additional temporary accommodation, and can carry a significant Embarked Military Force – such as Special Forces, littoral manoeuvre troops or additional C2 specialists.

## Through-Life Support

Babcock's through-life support assures ship availability, reliability and cost-effective readiness, including optimal integration of peo-



**Damen Schelde's SIGMA 5515 design is regarded as a strong contender for operational and technical reasons.**





Photo: Naval Group

***iXBlue delivered the first cybersecure navigation system for the French Navy's FDI fleet in September 2020. The BELHARRA design offered to the HN is reinforced by very positive political factors.***

ple, processes and technology. The latest mobile, remote and connected technology ensures systems can provide operators and maintainers with in-depth understanding of the performance, maintenance and material condition of their assets.

**NAVAL GROUP** submitted a new offer for the modernisation of the Hellenic surface fleet, as part of the French Team that also includes MBDA. The team described its offer as "comprehensive and robust... designed to ensure Greece has the best capabilities in the shortest timeframe with optimised costs." The package includes: a) four FDI HN - three built in Greece, the first in-service by 2025 along with a "Gap-Filler" solution of two frigates available in early 2022; b) modernisation of the MEKO frigates in Greece; and c) an ambitious Hellenic Industry Participation (HIP) plan. The French offer "will ensure that HN capabilities are enhanced to meet immediate and future needs, while creating and sustaining jobs and economic benefits for the country over decades to come." The FDI HN will be fitted with a weapons mix offering significant control of air and sea space, and autonomy in support of political and military objectives.

The FDI HN incorporates some of the best technologies from Europe's defence industries, particularly MBDA and Naval Group. The ASTER system gives 360° coverage and can counter saturation attacks, and the FDI can accommodate Naval Cruise Missiles and a Deep Strike capability. Physical and digital infrastructures of the FDI offer evolutionary potential for the life of the ships. The first FDI HN would be delivered in 2025. Naval Group offers a reduced-risk solution for the construction of the three subsequent FDI HN in Greece, by Greek shipyards, on time, and with the same quality and performance as the France-built first of class.

#### **Gap Filler Solution**

The French offer includes two Anti-Air Warfare (AAW) and Anti-Submarine Warfare (ASW) frigates, to be delivered to Greece in 2022. Both frigates are operational in the French Navy, proving they are fully capable and interoperable.

MEKO Modernisation in Greece. Naval

Group has formed a local partnership for the MEKO upgrade that guarantees operational availability and is executed in Greece.

#### **Hellenic Industry Participation Plan (HIP)**

The involvement of Hellenic industry "will enhance the country's excellence in the naval domain and create long term economic benefits and jobs as well as ensuring the warships will be maintained in Greece by Greek industry." The HIP will sustain "thousands" of highly qualified jobs and generate long-term economic benefit: "FDI HN: made in Greece, by the Hellenic Industry, for the Hellenic Navy!" The HIP plan will contribute to the revitalisation of Greece's defence shipbuilding industry, by transferring all the necessary technology and knowledge, maximizing Greek industry in-service support for the next 40 years, and participating in the long-term development of profitable, innovative, highly qualified jobs for Greek citizens - not only shipyards but also in electronics, IT, and more. Naval Group is already in contact with most if not all Hellenic

companies that might join the FDI HN programme. All qualified Greek companies will be integrated into the French industrial team's supply chains, thus able to participate in and benefit from future international competitions.

#### **A centre for naval innovation.**

Naval Group has strong interest in R&D projects with Hellenic organisations in cutting-edge technologies, and is looking to develop a network of technological and research projects upon which to build future naval warfare capabilities.

#### **The Others**

tkms from Germany responded to our invitation, with a polite refusal to reveal specifics of their strategy, solutions or promises. There was no response from Damen or Fincantieri in the time available.

#### **Conclusion**

This is an interesting programme, with a range of possible solutions, from sub-3000 ton corvette to frigates double the size. It has clearly taxed the imagination of industry in terms of adding value and creating solutions to problems that mostly revolve around urgency but are significantly challenged by the real world of money, risk and threats. Its successful launch and conclusion will be a hugely positive sign for Greece, the EU, NATO and the eastern Mediterranean.

The final Hellenic Government decision on the type and origin of the new frigates remains scheduled for 2021. ■



Photo: NATO / Royal Navy / Paul Hall

***The MEKO200 HN from Germany is one of the shortlisted contenders for the Hellenic Navy frigate programme***



## Viewpoint from Ankara



Photo: Andreea Stoian Karadeli

# A New Wave of Refugees from the Afghan War?

Andreea Stoian Karadeli

The Taliban have now taken control of Afghanistan after a 20-year struggle that has led to an indisputable human and material loss. For now, Turkey has assumed the key role of guarding Kabul airport – currently the only gate to the world for the Afghan population and the foreigners who want to leave the country. Meanwhile, thousands of Afghans have fled and walked through Iran in the past weeks, trying to illegally cross Turkey's borders. Ankara is willing to play hard ball on the Afghan card, but this game might prove more costly than previous ones.

### Beyond the Chaos: Setting up the New Stage

As the Taliban forces acted faster than any observers expected, the planned Western withdrawal has turned into total chaos. Currently, Kabul airport, secured by Turkish, US and UK forces, is the only way out to the outside world.. While the Taliban have made it clear that they will not accept any foreign troops on the ground, Ankara is using its diplomatic skills to negotiate with the group via Pakistan and Qatar. It is still unclear what the future will bring for the Afghans, but, as the West withdraws, and Turkey is showing interest in reaching out to the Taliban, China and Russia have not closed their embassies in Kabul. After 20 years, Western democracy has made an emergency exit in a US Air Force plane with a symbolic registration number: 1109. In a karmic way, this picture closes the circle on the 9/11 war on terrorism..

### A New Refugee Wave

In its bid to assume a greater role on the new stage, Turkey is now, deliberately, a destination and/or transit country for refugees fleeing Afghanistan. The Anatolian geography has always been exposed to such migrations throughout history but the current influx of Afghan refugees has several particularities that can only be compared to the first and second wave of refugees

coming from Syria after 2011. Nevertheless, Afghans fleeing to Turkey is not a new phenomenon, but rather a continuous process. The first Afghan refugees came to Turkey back in 1980 and most of them have been living in the southern region of Van ever since. The current Afghan emigration to Turkey has increased after the US decision to withdraw from the country. At present, it is estimated that between 500 and 2,000 Afghan refugees are arriving in Turkey every day. According to official statistics, Turkish authorities have caught more than 32,000 irregular migrants of Afghan origin in the first half of 2021 with the total number of Afghan nationals caught in the past five years reaching nearly 500,000. But the real numbers and ethnicities of those refugees are very hard to determine. And this might be, in fact, the real threat – the unknown.

### Young Men with Military Experience

This new wave of refugees has raised numerous security concerns in Turkey. As there is no clear record of the influx, any kind of speculations can be made. Bearing in mind the experience of the Syrian war, many of the terrorist groups can infiltrate members among the refugees who eventually become perpetrators of terrorist attacks. Most of the refugees coming from Afghanistan are young men with military experience. Some of them previously served in the Afghan Army, Afghan Police, and Special Forces. Therefore, it is not just a case of immigrant families or simple civilians. These are people with combat experience and war trauma who need special assistance to adapt and integrate in a community. There is a high rate of criminality among the groups with similar particularities, currently threatening security within Turkey. As a matter of fact, the perpetrator of the Reyna attack in Istanbul followed a similar route on his way to Turkey and waited silently for the right moment to carry out the attack. The possibility for similar profiles to escape the security measures, enter Turkey, and eventually plan attacks, is very high.





Photo: US Marine Corps

**Evacuees stage before boarding a C-17 GLOBEMASTER III during an evacuation at Kabul Airport, Afghanistan, on 18 August 2021. US soldiers are assisting the orderly drawdown of designated personnel in Afghanistan.**

## Cultural Aspects

Moreover, other factors such as the sociological, economic, and cultural aspects bring into question the ability of those refugees to adapt to their host country and integrate within the local communities. The Syrian refugees are already a pressing issue within Turkish society, which has already faced many challenges in recent years: terrorism, war in its neighbourhood, unemployment, the pandemic and economic crisis. Recent images of Afghan refugee groups dressed in military uniform walking around in Istanbul triggered considerable controversy among the Turkish population.

## Iranian Interests

Migration should be understood and accepted as an international issue regardless of the geographical region affected. While Iran has been hosting over 3 million Afghan refugees, Tehran has strategically designated some of those as fighters in its proxy wars. But the current flow is heading directly into Turkey, serv-

ing in many ways the Iranian interests. Moreover, the concept of border implies a collaborative act between two neighbouring countries. If a border is only protected on one side, it will never be possible to fully ensure the safety and security of the country. Unfortunately, just like in the Syrian situation, Turkey is mostly alone protecting a vast border area. The border between Turkey and Iran is 534 km long and spreads over four main regions: Iğdır, Ağrı, Van and Hakkari. In 2017, Turkey started to build a 144 km long wall along the border to prevent illegal crossings and smuggling. In 2020, 57.2 km of the wall was built on the border of Iğdır and 86.8 km on the Ağrı border, with the construction for the rest of the border ongoing at full speed. Ankara has also increased the number of its security forces in the region, but one-way measures are not sufficient. Unfortunately, the current Trojan horse now knocking at Turkey's borders equally has the potential to become a threat to European soil. Turkey might be a suitable actor for the new power game in Afghanistan, but everything has its price. Negotiating with the Taliban, while keeping a foot on the ground, and facing a new wave of refugees, is not an easy task for the officials in Ankara.

# Tank Gun and Ammo Developments: 120mm and Above

**Henry Richardson**

**As the West continues to reorient to conventional warfare in the face of a confrontational Russia, the need to continue to develop ammunition for Main Battle Tanks (MBT) in order to assure overmatch against the latest Russian tanks including T-72B3M and T-90M is critical.**

While many countries continue to develop ammunition for existing 120mm guns, France and Germany are continuing to develop and mature technology for the future of MBT armament.

## 120mm

For the time being, at least, 120mm remains the standard large direct fire calibre for tanks in the West, and indeed in much of the world other than those supplied by Russia and China. Commensurately, 120mm has seen some of the most active development, with new natures and weapons having been revealed recently. It is broadly agreed that 120mm is near its zenith of performance, and that any further step change capabilities beyond those currently planned will require an increase in calibre or an as-yet unknown materials science breakthrough.

## France

In March 2021, Nexter unveiled their latest APFSDS round development, the 120 SHARD. This round is in the final stages of development ahead of a move to series production from early 2022 and is stated by the company to have been optimised to be capable of defeating all current and future passive and reactive armour systems.

The claim has not been validated with empirical data but would need to be performing at or beyond those of the latest peer penetrators including the US M829A4, which utilises a depleted uranium (DU) penetrator. SHARD is stated to use a combustible cartridge case with a D10 tungsten

Photo: Nexter



**Nexter SHARD, a new 120mm APFSDS round**

Photo: KMW



**Germany's LEOPARD 2A7A1, the latest LEOPARD 2 development, will mount the L55A1 main gun and ultimately will fire the KE2020Neo round. It is will also be fitted with the TROPHY HV Active Protection System (APS).**

carbide alloy penetrator developed in concert with Plansee Tungsten Alloys. The key difference to existing French rounds such as F18 and F18+ is the penetrator length. Following extensive developmental work the length has been significantly increased, and the propellant volume also increased following a reengineering of the sabot, petal and case, leading to a claimed 20% increase in penetrative performance when compared to existing rounds.

The 120 Shard is part of a family of new French 120mm rounds that includes the POLYNEGE guided round, which is able to terminally guide onto a designated target including non-line of sight (NLOS) engagements at up to 8 km using technology developed from the Nexter KATANA 155mm artillery round. A programmable high explosive (HE) round is also being developed to provide a broadly similar capability set as the US XM1147 Advanced Multi-Purpose (AMP) round.

## Author

**Henry Richardson** is a defence consultant based in London and specialising in western land forces and armoured vehicle technology.



Beyond ammunition, Nexter is also developing an all-new tank gun, the AS-CALON (Autoloaded and SCALable Outperforming guN). ASCALON is a novel design approach, using cased telescoped approach to ammunition in a large calibre format with an "open architecture" approach that the company hopes will see it form the basis of a future Franco-German MBT under the MGCS programme. The cased telescoped approach allows, says the company, an unparalleled length of penetrator to be achieved with an overall projectile length of 1,300 mm delivering equivalent or superior performance to existing 120mm APFSDS rounds but with reduced muzzle blast and more readily integrated with lighter weight platforms than typical MBT applications.



Photo: Rheinmetall Defence

**A CHALLENGER 2 testbed hull mounting Rheinmetall's new turret and 130mm L/51 smoothbore gun**

## Germany

As could be expected given its strong track record in the manufacture and development of smoothbore 120mm guns, which arm a substantial portion of the world's MBTs either directly or via licenced production and development, Germany is very active in development of new versions of its gun and of new ammunition natures for them.

In response to a need to continue to improve the performance of the 120mm smoothbore gun design, Rheinmetall developed the improved L55A1 standard in 2016. The main difference between the baseline L55 and the L55A1 is an increased pressure level resulting in a claimed 20% increase in penetration. The L55A1 is the de-facto standard weapon for latest examples of the

LEOPARD 2 tank, with the latest LEOPARD 2A7-series, including the LEOPARD 2A7V, LEOPARD 2A7A1 and LEOPARD 2A7DK utilising the gun, as well as the guns for the Hungarian LEOPARD 2A7 purchase.

The legacy DM53 APFSDS projectile has already been improved to the DM63 standard, which replaces propellant with an insensitive munitions (IM) compliant



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Photo: Nexter



**The stark difference size between a 140mm round (left) and a conventional 120mm round (right) is evident. The implications for ammunition stowage and handling are self-evident.**

component. The latest DM73 has taken the DM53/63 projectile and through the use of a more powerful propellant achieves an 8% uplift in performance, and entered qualification trials with the Bundeswehr Technical Centre for Weapons and Ammunition earlier this year. DM53 rounds can be upgraded to DM63 or DM73 standard to reduce costs versus wholesale replacement of rounds. Looking further ahead, Germany is developing the KE2020Neo, an all-new APFSDS design intended to take the capability of 120mm armed tanks significantly up in capability by leveraging the full additional pressure margins of the L55A1 gun. The

novel penetrator design is also seeking to improve on velocity and terminal energy losses experienced due to drag, likely by increase length to diameter ratio of the round. Once more developed the round will be assigned a DM designation with a target fielding date of 2025, and early claims cite a potential 20% improvement in performance.

The KE2020Neo is also being looked at by the UK as a potential service KE round for the new CHALLENGER 3 MBT, being assessed against the US M829A4 depleted uranium round. A decision on which round the UK will use will be taken at CHALLENGER 3 Critical Design Review (CDR) in 2022.

### The US

The US has been somewhat more measured in its development of new large calibre weapons and munitions than its European neighbours, with only modest programmes around non-KE projectiles. The M256 gun, derived from the German 120mm smoothbore L44 gun family, remains the primary armament of the M1 ABRAMS tank fleet and is not expected to be replaced or upgraded in the near term.

The latest generation M829A4 APFSDS round, introduced in 2015, remains the service round for KE engagement, and remains a rare example of depleted uranium based penetrator design, where most users utilise tungsten-based designs. For US needs, the M829A4 appears to remain suitable, and instead effort has been directed to the consolidation of legacy ammunition types to a single nature under the XM1147 Advanced Multi-Purpose (AMP) effort. XM1147 AMP consolidates the capabilities of the M830 High Explosive Anti-Tank Multi-Purpose With Tracer (HEAT-MP-T), the M830A1 HEAT-MP-T, the M1028 CANISTER (CAN) round, and the M908 Obstacle Reducing With Tracer (OR-T) rounds into a single multipurpose ammunition nature. This would allow US tanks to deploy with just a two-round load, vastly increasing ease of supply and operation.

### 130mm

Rheinmetall continues to work on its L/51 130mm tank gun, first unveiled at the 2016 Eurosatory defence exhibition. The 8% increase in calibre of the weapon over the 120mm gun from which its design is derived brings a claimed 50% increase in penetrative capability. The increase in size carries with it an increase in weight of around 500 kg. With a 50% increase in chamber volume, the gun allows longer APFSDS round to be fired at higher velocities, with a target of reaching a 13-14 MJ impact energy target.

The single piece ammunition for a 130mm smoothbore gun is substantially larger than existing 120mm natures and would necessitate the use of an autoloader when fitted to a vehicle. The size and weight of the projectiles is too great to be handled by a single member of crew in the tight confines of a tank turret. It should also be noted that a move to a larger 130mm gun would significantly reduce the number of rounds that can be carried and require an all-new turret to be designed for most tanks, as the 130mm does not readily fit in existing turrets without major structural modification.

The first round developed for the 130mm system is an APFSDS round, with a high-explosive air bursting munition (HE ABM) derived from the 120mm DM11 program-mable HE round. One of the desires of the 130mm APFSDS is that it could engage targets at 4.5 km or more. However, there is some doubt as to whether a round could be sufficiently accurate and carry enough terminal energy to be effective at that range. There has been suggestion that a guided round or missile would be better suited to such long-range engagement envelopes.

Rheinmetall hopes that the future Main Ground Combat System (MGCS), a future tank design being jointly developed by France and Germany, will mount the 130mm gun, however it competes against a French desire to mount a larger still 140mm gun made by Nexter.

In early 2021, Rheinmetall characterised the 130mm gun as being around technology readiness level two or three, with the gun itself at around level three and the autoloader system around level two. With no committed customers at this time, Rheinmetall appear to be waiting for a decision on which weapon will form the main armament of the MGCS, due to be decided in 2022, before committing to faster development of the weapon system.

Photo: Rheinmetall



**The 130mm L/51 gun is a substantial increase in size and mass over the existing 120mm weapon, but is claimed to bring up to 50% increase in performance.**





## ARMORED VEHICLES

Nexter, land defense architect and system integrator in France, is a major reference in armored combat systems, artillery, and in the ammunition field. Nexter designs innovative solutions for land, air, sea and security forces, in order to bring French and foreign armed forces a decisive operational advantage.



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Photo: Nexter

**The so-called LECLERC "Terminateur", a testbed platform mounting Nexter's 140mm smoothbore gun on the existing LECLERC hull**

## 140mm

Nexter have long had a desire to market a 140mm tank gun, heavier than any other Western effort at present which is in many ways surprising given France's preference for lighter and predominantly wheeled forces. The company's 140mm tank gun is a vast increase in size and weight over a conventional 120mm gun and is claimed to bring with it a substantial increase in performance.

In 2019, footage was released by Nexter of the 140mm gun mounted to a LECLERC tank during static firing trials, not representing a potential application of the weapon for LECLERC but as a testbed platform to develop the weapon towards a notional application as the main armament of a relatively light tank, specifically the 50 tonne target for the MGCS tank. As previously stated, the German side of the MGCS team would like to see

the Rheinmetall 130mm gun used for MGCS, so a future down-select on main armament will need to take place, or less likely would be a divergence to two differing turrets and armaments to accommodate both countries. Nexter's 140mm gun draws lineage back to around 1990 when GIAT started development of the weapon and an enlarged turret called the T4 to mount it.

The 140mm gun is enormously larger and more powerful than extant 120mm weapons, with Nexter claiming up to 70% increase in performance compared to contemporary 120mm ammunition natures. Prior investigations by Germany, Switzerland, the UK and the US all in broad terms discounted it as though it brings substantial capability uplifts, the engineering burdens of handling the huge recoil impulses, and the practicality of handling and autoloading the vastly larger 140mm rounds, with commensurate decrease in total round capacity in the platform rendered it not good value versus smaller calibres. France has much of this data and knowledge but appears to remain resolute that a 140mm gun is still their preferred capability. ■

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# CBRN Protective Clothing

## Advances in Textiles and Technologies

**Dan Kaszeta**

There is a distinction between military CBRN protective clothing and civilian-sector hazardous materials protective clothing for use in industrial safety and emergency services operations. The latter are designed with different roles and risk assessments in mind. Although there is some overlap in the two market segments, this article covers the military market.

**C**BRN protective clothing is an important component in protection of military personnel from CBRN hazards. For the most part, CBRN protective clothing is chemical protective clothing as the nature of the chemical warfare agent threat becomes the key design criteria as it is chemical agents that comprise the principal threat to skin.

### Protection vs. Heat Stress

Design of CBRN clothing is based on battlefield missions and environments that soldiers work in, balanced with the ability to protect against the most pernicious of the chemical threats – blister and nerve agents. As such, military chemical protective clothing is always a compromise between safety (preventing the hazard from affecting the soldier) and allowing the soldier to operate on the battlefield. The general trade-off is between chemical protection versus heat stress. The best barrier material (plastics and rubbers) also provide a high level of heat stress that might end up killing and injuring more soldiers than any chemical attack would. The history of CBRN defence has been, in part, a history of developing clothing that tries to find the right compromise. In the last 50 decades, chemical protective clothing has become more advanced, less burdensome on the wearer, and often more expensive.

One way to examine this subject is to do a historical cross-section, using the USA as an example. The US market has long



Photo: US Army

*Two soldiers inspect the other's JSLIST suits for a CBRN attack on US soil.*

driven this area. The US Army's experience is broadly similar to those of the major European militaries.

### Non-Permeable Suits

The oldest approach to military chemical protective clothing was non-permeable suits that protected by forming an impermeable barrier. In the 1960s, the M3 Toxicological Agent Protective Suit (TAP) was an extensive set of butyl rubber and rubber-coated textiles. It was a full suite of items that took half an hour or longer to don and was intended for serious chemical defence tasks like decontamination. In hot weather, it would have been as deadly to wear as the agents it was protecting against. It (and its even less pleasant Soviet equivalent – still serving in places) was not a tool for a warfighter. The TAP apron, though, lives on in the US Army Chemical Corps in decontamination duties.

### Permeable Protective Clothing

Most major western militaries started the gradual shift towards permeable protective clothing and getting away from the harder impermeable barriers. Butyl rubber and similar materials are still frequently found in boots and gloves, but from the 1970s onward, the idea caught on that permeable suits which could safely absorb or adsorb chemical hazards while allowing some heat and moisture to escape would be more wearable by soldiers in wartime conditions. This was true, up to a point. Heat stress was (and still is) a serious issue, but it became possible for the rank and file to wear protective clothing.

### Charcoal Suits

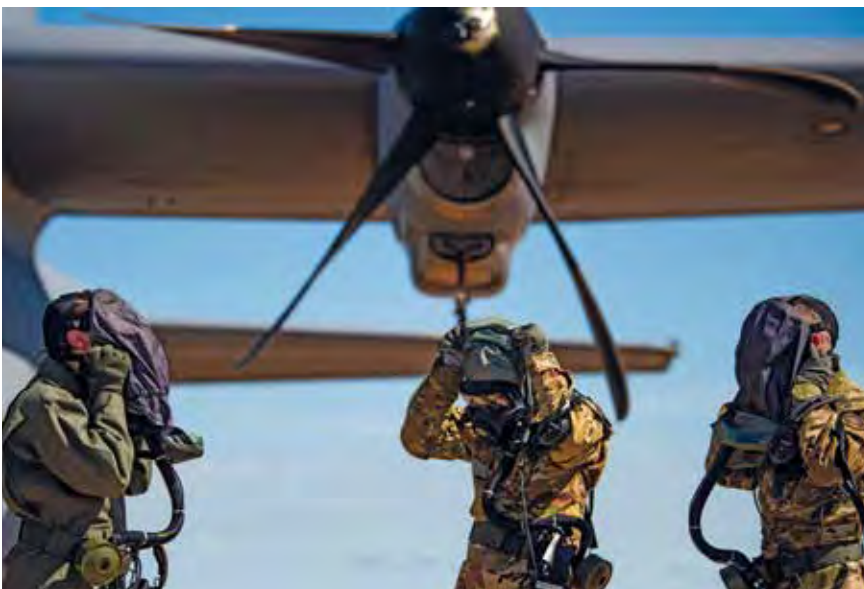
The US Army had a suit called the "Chemical Protective Overgarment" (late 1970s-early 1990s) and its successor the "Battle Dress

### Author

**Dan Kaszeta** is Managing Director at Strongpoint Security Ltd. and a regular contributor to ESD.



**Experience with JSLIST suits is required for all officers taking classes on CBRN, High-Yield Explosive, Post-Attack Reconnaissance and Shelter Management.**



**Airmen remove their gas masks next to a C-130J SUPER HERCULES at Dyess Air Force Base, Texas. The aircrew demonstrated the operability of the new UIPE suits during simulated preflight and ground egress procedures.**

Overgarment" (late 1980s-late 1990s). These use activated charcoal in a layer between inner and outer textile layers. The idea was that these "charcoal suits" as they became known, would absorb or adsorb droplets and vapours of nerve and blister agents. They were quite effective and could be worn for days or even weeks before they lost their effectiveness. The UK's equivalent, the Mk4 suit, with its carbon-impregnated felt layer was very similar.

Gulf conflicts in the early 1990s used up much of the inventory of the West's Cold War-era charcoal-based suits and in doing so demonstrated that the existing suits were still too hot. Charcoal suits, while they still exist, have largely been supplanted, from the 1990s onward by more advanced, breathable textiles, many of which are quite proprietary in design. Pushed heavily by the US DoD Joint Service Lightweight Integrated Suit Technology (JSLIST) procurement effort, new textiles came into service.

### JSLIST Suits

JSLIST suits and their equivalents in other countries replace bulk charcoal or carbon with small spheres of adsorbent carbon embedded in the actual fabric, resulting in a lighter fabric with less heat stress. The suits themselves are even launderable a number of times, resulting in the ability to stretch a stockpile of them further in actual operations. The author has direct operational experience over the course of this broad arc of development and can attest that the JSLIST-era suits, which came into service in the late 1990s, are indeed a more comfortable item. Blücher (Germany) and its subsidiary Tex-Shield (USA) are examples of manufac-

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turers of this technology. A key manufacturer in the space, Remploi (UK) no longer makes such suits, but OPEC Systems (UK) has picked up the former Remploi product line in this space. Paul Boye (France) is also a key player in this space. A number of smaller players serve national markets.

The great rival to such technologies is Gore, famous worldwide for its “Gore-Tex” waterproof garments and fabrics. W.L. Gore and Associates (USA) have adapted their technology to CBRN defence. Their “ChemPak” technology uses selectively permeable membranes to let air in, moisture out, and prevent chemical hazards from passing through the garment.

## Room for Improvement

CBRN protective clothing is clearly an area where there is room for improvement. The ideal – a CBRN protective suit that is, in effect, as easy and cheap to wear as a regular combat uniform – still eludes the defence industry. But we are not actually all that far off. Current CBRN suits are more burdensome than, say, 1980s-era US Army BDUs, but not by a massive margin.

Significant scientific and technical efforts are underway to provide the next generation of CBRN protective clothing and textiles. The next great generational improvement in the US military is one that will also cascade into the USA’s allies, both directly through foreign military sales and indirectly through manufacturers having the new products in their catalogues and product lines. JSLIST is being replaced by the Uniform Integrated Protective Ensemble (UIPE) family of products. UIPE has a long history already, with millions having been spent over the last decade. Gore and Paul Boye, among others, have participated in the UIPE effort. Currently, military aircrew versions of the UIPE are being tested in operational environments by the US Air Force in Texas.



Photo: US Air Force / Senior Airman Dwane R. Young

**Airmen pose for a photo in full CBRN gear at Nellis Air Force Base, Nevada. The Airmen participated in on-going testing of the new UIPE suits.**

## Outlook

Beyond the UIPE, where is the future in this field? Some new products will no doubt emerge from the existing technologies in the form of incremental improvements.

New materials and new textiles continue to be invented for various purposes, which could be adapted to CBRN protective clothing. One approach may be to get beyond barriers, permeable or otherwise, and beyond adsorption. Is it possible for clothing to actually neutralise chemical warfare hazards? Recently published research in the journal ChemCatalysis looks very promising. A research project on “metal organic frameworks” done by the US Army and Northwestern University show that it is possible to make a hydrogel that can neutralise nerve agents. This hydrogel can actually be integrated into a layer

of cotton cloth in a uniform or protective suit. While protection against nerve agents is only part of the threat, perhaps multiple hydrogels could be developed so that blister agents could be addressed as well.

Using the same tactic, DARPA is funding work into “Personalized Protective Biosystems.” This programme wants to look into embedding catalysts (of which the hydrogel work above is only one approach) into suits, clothing, and gloves. These catalysts could neutralise chemical threats. FLIR (USA) has been awarded a USD 20 million contract on this project. We do not know what the CBRN textiles of the future will look like. Will they be an advanced “Gore-Tex” type material? Or a regular duty uniform treated with special substances? Or some combination thereof? This is a market segment that bears watching. ■



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# Viewpoint from Tbilisi



Photo: Beka Kiria

## The Caucasus – A Melting Pot for the Global War of Ideas

**Beka Kiria**

Director of the Gagra Institute

The myriad of complexity is the hallmark of the South Caucasus as expressed in historical power archetypes and contrasting political legacies. The present state of affairs of the three Republics – Georgia, Armenia and Azerbaijan - underlines that they have turned into a hotspot of global power dynamics. These small neighbouring states lie at an intersection of the 'global war of ideas'. The traditional model of political thinking through the lens of geographic topography sets solid boundaries between the Middle East and the Caucasus region, regarding them as two distinct entities. However, through the prism of political geography, these adjacent regions are part of the most significant geopolitical setting in the world. Specifically, the Middle East is considered to be the region's heart, characterised by the clash of global and regional hard powers, with the Caucasus seen as the playground for soft powers. From a scholarly standpoint, the intense and dynamic global hard/soft power struggles – the Middle East and the Caucasus - are a major laboratory for observing geopolitics at play. The very nature of hard power competitors in the Middle East is mostly chronically subversive and projected through military engagements. Nevertheless, the South Caucasus political microcosm lies at the epicentre of soft power rivalry.

### A Deeply-Rooted Sovietism

The year 2021 marks three decades of experimentation with liberal democracy in the South Caucasus. This was an attempt to transition from the heavily-rooted Sovietism, moving away significantly from communism. In this brief period of history, Georgia managed to become a 'partly-free' state, joined shortly after by Armenia, though Azerbaijan has remained 'not free'. On the way to the profound transformation towards building liberal democracy, Georgia took this path thanks to considerable assistance from the United States. Armenia's own desire to repeat the same came in the aftermath of the Velvet Revolution, but without much international support. Azerbaijan tried to simulate liberal democratic provisions in the early 2000s, but then abandoned that path.

The US, EU, Russia and China are all heavily engaged in the South Caucasus. The US is actively promoting liberal democracy, while the EU is endorsing a spectrum of liberal-social democracy under the guise of Euro-Atlanticism. Russia is pushing its émigré community-bred Eurasianism. Moreover, China's efforts, once regarded as a hindrance to modernisation and socialism, are now led by Xi Jinping's Confucian New-Eurasianism.

The USA's liberal democracy project and the EU's liberal-social democracy efforts began to spread in Georgia, Armenia and Azerbaijan after the collapse of the USSR. Georgian governments enjoyed strong support from the Euro-Atlantic political order, and the country experienced a profound economic, social and political transformation. Georgia then forged close ties with NATO and the EU. As a result, Russia experienced a sharp decline in the region and invaded Georgia in 2008.

### Russia and Azerbaijan

Russia has held a firm grip on Armenia since its independence, making it part of the Collective Security Treaty Organization (CSTO). The US and EU engagement with Armenia mainly encompasses humanitarian and technical assistance. The EU has been more active in spreading liberal-social democratic values through its vast financial support to Armenia's thriving civil society.

When it comes to Azerbaijan, Russia tried to keep the country firmly under its substantial influence until 1999, when both Azerbaijan and Georgia refused to sign the CSTO membership renewal protocol and instead withdrew from the treaty. Azerbaijan also enjoyed strong US support, especially in the economic sphere, primarily in the field of Caspian energy resources and their link to the Western markets. The US Government actively supported the Baku-Tbilisi-Ceyhan pipeline as the main transportation route for Caspian oil.

US interests in the South Caucasus are primarily focussed on the Black Sea countries and the Caspian Sea basin, where Azerbaijan is the closest US ally. Despite US ties to Azerbaijan, the country is way behind in democratic governance, and the US



idea of liberal democracy is not a dominant political ideology in the country. The Government has introduced changes in legislation, and by 2014, foreign funding was almost non-existent for Azerbaijani civil society. Its rich oil and gas resources make the country the least foreign-influenced sovereignty in the South Caucasus.

During the recent Azerbaijan-Armenia war, the US' silence on the conflict reflected Washington's desire not to damage its strategic interests in the region. China followed the same approach, which was explained mainly as China's non-intervention policy in the region. However, the aftermath of the Nagorno-Karabakh war gives the US a window of opportunity to integrate Armenia into regional development, thereby reducing Russian engagement as long as Eurasianism is no longer appealing to Armenia.

Therefore, China's involvement in the South Caucasus has different limits and dimensions in each of the republics. For instance, China and Georgia signed a free trade agreement in 2017, and the Georgian Government had high expectations for the development of Batumi, Poti and the Anaklia Deep-Sea Port, and the Baku-Tbilisi-Kars (BTK) railway and East-West Highway. Georgia has been transformed into the regional hub for logistics and transit, integrating with the 'Belt and Road Initiative', foreseen as a junction linking the Indo-Pacific region to the European market. However, the geopolitical competition involving the US, China and Russia has since delayed the Deep-Sea Port construction efforts as the US perceived Chinese and Russian investments in the port as an issue.

Besides US interests in the South Caucasus, the EU has serious interests in the region through the Eastern Partnership and the Transport Corridor Europe-Caucasus-Asia (TRACECA) projects. A similar logic was applied in Baku and Tbilisi to boost its transport and energy corridor by investing in Baku's ports and building an additional port in Alat. The Trans Anatolian Natural Gas Pipeline Project (TANAP), which sends Azerbaijani gas across Georgia and Turkey to southern Europe is generously funded by China.

Photo: US Army



**US Army STRYKER IFVs being unloaded at Vaziani military base near Tbilisi for exercise NOBLE PARTNER 2017. Vaziani military base with its training areas has been chosen as a site for the planned joint NATO-Georgia training centres in accordance to the Wales Summit 2014 agreement.**

## Chinese Investments

Similar to Georgia and Azerbaijan, Armenia has attracted Chinese investment to fund the construction of the North-South Corridor. The highway allows Armenia to connect the global value chains of its economy through Georgia, having gained access to the port of Poti and also Batumi and Iran's southern markets. China also funded the construction of the Gyumri Road to Georgia and the smart city in Armenia with a budget of about US\$15Bn.

China is acting in the South Caucasus primarily as an economic actor within the 'Belt and Road Initiative'. When it comes to spreading its Confucian New-Eurasian ideology, both Georgia and Azerbaijan have abstained, however, Armenia is the first country of the three to host 'The Confucius Institute' with its links to the Chinese Government and which is a tool of soft power, along with many other Chinese educational institutions operating throughout the country.

The Caucasus is indeed a melting pot of the global war of ideas and is experiencing fierce competition involving US, EU, Russian and Chinese political ideologies. On a similar scale, India is a newcomer with its growing engagement in the South Caucasus. The nature of the rivalry between the global powers is expressed not only on the ideological front, but also on the domestic economy, security and politics. The layer below the global power rivalry is a regional layer of intense competition in the South Caucasus, involving players such as Turkey, Iran, Russia, Saudi Arabia and Israel.

# Rise of the Robot Warrior

**Doug Richardson**

An early military application of robotic technology was the creation of unmanned ground vehicles (UGVs) for explosive ordnance demolition (EOD) tasks. More recently, robotic systems have been used for short-range reconnaissance, particularly during urban-combat operations. Arming robotic platforms with weapons intended for use against enemy personnel, vehicles, or other point targets, is the latest development.

**M**uch reduced in size from the 364,000 soldiers it fielded in 1950, the British Army currently numbers around 82,000, a modest figure not seen since the closing years of the 18th century. Speaking to the Sky News television channel in November 2020, UK Chief of Defence Staff General Sir Nick Carter predicted that by the 2030s, the British Army might have around 120,000 soldiers, but about a quarter of these could be robots.

UGVs can make soldiers more effective, and reduce the casualty rate. One possible role is to operate several kilometres ahead of friendly forces, detecting and engaging the enemy, and providing the tactical information that will allow units to advance and conduct an effective operation. UGVs may prove particularly effective in urban warfare, while the ability to accept robotic 'casualties' may help ground units to deal with the human-shield tactics sometimes used by irregular forces.

## Remote-Controlled Robots

The simplest method of creating a UGV is to adapt an existing manned vehicle for remotely-controlled use. In 2019, the UK announced that some Army fighting vehicles would be fitted with a remote-control capability, so they can be sent ahead of manned vehicles to test the reactions and combat strength of enemy defences. Russia's VIHR (HURRICANE) is another example of an adapted vehicle. It is based on the chassis of the BMP-3 armoured fighting vehicle, so can exploit existing maintenance and repair

Photo: US Army



*Developed for the US Army, Foster-Miller's Special Weapons Observation Reconnaissance Detection System (SWORDS) was sent to Iraq in 2017, but was never adopted for service.*

## Author

Following an earlier career in engineering, **Doug Richardson** is a defence journalist specialising in topics such as aircraft, missiles, and military electronics.





Photo: US Army

## US Robotic Programmes

Developed by Foster-Miller for the US Army, the Special Weapons Observation Reconnaissance Detection System (SWORDS) was a weaponised version of the company's TALON remotely operated vehicle. Designed to carry armament ranging from an M16 rifle to a 40mm grenade launcher or a 66mm M202A1 FLASH (FLame Assault SHoulder) incendiary weapon, it was deployed to Iraq in 2017 in three examples of a variant armed with a Squad Automatic Weapon (SAW) M249 machine gun. These may have seen limited use in surveillance and peacekeeping/guard operations, but were soon withdrawn.

By 2021, the US Army had around 20 robotics programmes underway. One of the most important is the Robotic Combat Vehicle programme. This envisages light (under 10 tons), medium (under 15 tons), and heavy weight (20-25 tons) robotic vehicles able to be integrated with a range of payloads able to meet future requirements. These could include high-resolution long-range targeting sensors, as well as weaponry ranging from machine guns to antitank missiles. Artificial intelligence (AI)

facilities. However, this approach results in a large and heavy system, given that the chassis was originally intended to house a crew. Most UGVs use a custom-designed wheeled or tracked chassis. This is normally powered by one or more electric motors, a small internal combustion engine, or a combination of the two. Most current designs rely on remote control via a radio or fibre-optic link. Some have a semi-au-

tonomous navigational ability intended to reduce the operator's workload. During research for this article, the author looked at the specifications of more than 100 UGVs currently being marketed, or known to be under development, for which a combat role is claimed. Such numbers make it impossible to describe more than a handful within the confines of a magazine article.

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**Now in production for the Russian Army, the URAN-9 had an inauspicious debut when sent to Syria for combat trials. The weaponry and sensors could not be used while the vehicle was moving, and the radio link between the vehicle and its control station proved highly unreliable.**



**This demonstration of autonomous navigation by UGVs was conducted earlier this year by Milrem Robotics using two of its THeMIS vehicles. At one point in the exercise, an operator took control of one UGV using Line of Sight (LoS) control, and ordered a second THeMIS to follow the first one from one waypoint to another.**



**Milrem Robotics designed its TYPE-X COMBAT vehicle to support mechanised units and main battle tanks. Its 25-50mm autocannon is intended to provide the firepower normally associated with infantry fighting vehicles.**

technology could allow target data to be automatically processed, then transmitted to army ground-based units and to airborne assets such as attack helicopters, armed UAVs, and close-support aircraft.

Textron Systems and QinetiQ have been awarded contracts to build light and medium weight platforms. In November 2020, QinetiQ Inc. and Pratt Miller Defense delivered the first of four Robotic Combat Vehicle – Light (RCV-L) to the Ground Vehicle Systems Center (GVSC) of the US Army Combat Capabilities Development Command (CCDC). It combines the Pratt Miller Expeditionary Modular Autonomous Vehicle (EMAV) and with QinetiQ's Modular Open System Architecture (MOSA) robotic control systems, and was designed to be payload-agnostic. Early in 2021, Textron Systems and Howe & Howe delivered the fourth and final RPSAW M5 medium-weight robotic vehicle to the US Army.

To supplement these vehicles, the US Army has modified four M113 armoured personnel carriers to act as RCV surrogates. All three types, plus Mission Enabling Technologies Demonstrators (MET-D) configured to serve as RCV control vehicles, will take part in a Soldier Operational Experiment (SOE) planned for 2022. The experience gained should allow further refinements to be made to the prototype and surrogate vehicles before the programme begins a Phase III cycle expected to include an SOE tentatively planned for FY26.

## Russian Developments

Russia has developed many models of UGV, and made limited use of its URAN-9 in Syria. Created by JSC 766 UPTK, this is a tracked vehicle weighing around 12 tons, and carries a turret armed with a 30mm 2A72 cannon, a 7.62mm coaxial machine-gun, and four 9M120-1 ATAKA anti-tank guided missiles. Combat use of the vehicle in Syria showed many problems. Control of the URAN-9 is via a radio-based data-link, but this proved unreliable, allowing the vehicle to operate at ranges of only some 500 m from its manned control station. Communications dropouts were not uncommon.

The sensors and armament were not stabilised to allow their use when the vehicle was on the move, so the URAN-9 had to stop in order to use them. When a command to fire was sent, on six occasion there was a time lag in the response, and on one occasion the vehicle did not fire. Reliability problems were also experienced with the armament and suspension system. These poor results probably triggered a programme of modifications. By 2019,



URAN-9 had been accepted for service by the Russian military, and series production had begun.

The UK's Project Theseus is intended to develop and field-test autonomous logistic resupply systems. It will use three Horiba MIRA VIKING 6x6 all-terrain UGVs able to carrying up to 750 kg of supplies to front-line troops. These vehicles will use AI to allow navigation in GPS-denied situations. The Estonian company Milrem Robotics will supply two further UGVs to QinetiQ, which will install autonomous functions in these vehicles before delivering them for trials.

## Milrem's Developments

Milrem Robotics has developed many versions of its Tracked Hybrid Modular Infantry System (THeMIS). These share a common basic configuration consisting of two tracked propulsion assemblies positioned on opposite sides of a central platform. All the hardware for the hybrid diesel-electric drive is located within the propulsion assemblies, leaving the central platform free for mission-specific equipment. This layout simplifies the task of creating new variants, and a series of these have been displayed at recent defence exhibitions.

As its designation suggests, the Tracked Hybrid Modular Infantry System (THeMIS) ADDER uses the Singapore Technologies Kinetics ADDER remote weapons station armed with a two-axis stabilised single or dual weapon, ranging from 7.62mm machine gun to a 40mm automatic grenade launcher.

Developed in conjunction with Kongsberg Defence, THeMIS PROTECTOR can carry armament ranging from a machine gun to a JAVELIN anti-tank missile system. Perhaps the most ambitious member of the family is that which carries an MBDA Integrated MMP Precision Attack Combat Turret (IMPACT) fitted with two MMP fire-and-forget antitank missiles and the associated fire-control system, plus a 7.62mm machine gun. A two-way datalink allows man-in-the-loop control of the missile.

Anyone catching a distant glimpse of Milrem Robotics' new TYPE-X Combat UGV can be excused for mistaking it for an obsolete British CENTURION main battle tank (MBT). But despite this resemblance, the company's latest creation weighs only 12 tons. Developed to support mechanised units and MBTs, it can use a turret-mounted autocannon of 25-50mm calibre to engage lower-range targets.

A second variant of the TYPE-X can be fitted with a Multi Canister Launcher for two UVision Loitering Munition Systems—either the HERO-120 with and antitank warhead



Photo: IDF

**The Israel Defense Forces are using the IAI JAGUAR UGV to help patrol the border between Israel and Gaza. Equipped with sensors, headlights, a public-address system, and a 7.62mm machine gun, it can self-destruct should it fall into enemy hands.**



Photo: Turkey's Presidency of Defence Industries

**The Best Group's FEDAI UGV is one of several designs vying for an order from the Turkish military.**



Photo: Turkey's Presidency of Defence Industries

**Another candidate for an anticipated Turkish order is the Elektroland Defence HANCER, which uses a propulsion system based on four tracked assemblies.**

Photo: Georgia Tech



**At Georgia Tech, Professor Ronald Arkin (left) is developing algorithms that will allow a robot to use tactics intended to deceive a human or other robot, reducing its chance of being detected and tracked. In this test conducted by Arkin and research engineer Alan Wagner (centre), the black robot deliberately knocked down the red marker in order to deceive the red robot, then hid inside the box seen on the right.**

and a flight time of up to one hour, or the HERO-400EC capable of destroying fortified targets, and remaining airborne for up to two hours.

Two types of control system are currently offered – remote control, and waypoint navigation. 'Follow me' guidance is currently under development, as is a swarming capability. An optional telescopic rising mast carrying the communication antenna will allow remote control at ranges of up to 40 km.

In May 2021 the IDF announced that it had deployed the Israeli Aerospace Industries JAGUAR 1.5-ton unmanned wheeled ground vehicle as part of its border defences around Gaza. The vehicle is reported to be semi-autonomous in that it can use AI to manoeuvre around obstacles along its programmed route, or to go to a recharging point when its power level is low. Turret-mounted electro-optical and thermal sensors can detect humans, but the decision to engage these with the turret-mounted 7.62mm machine gun is taken by a human operator. Final aiming and fire-adjustment are reportedly handled by an AI subsystem.

Four Turkish companies are competing to offer a medium-class tracked UGV to their country's armed forces – Aselsan with the ASLAN (Lion) UGV, Best Group with the FEDAI (Bodyguard), Elektroland Defence with its HANCER (Dagger), and Havelsan with the BARKAN. All are armed with Aselsan's SARP, a remote-controlled weapon system able to mount

a 7.62mm or 12.7mm machine gun or a 40mm grenade launcher.

### Autonomous UGVs

The prospect of autonomous UGVs able to use AI to provide independent decision-making in the use of weapons has attracted concern by organisations such as Amnesty International, Human Rights Watch, and the International Committee for Robot Arms Control, but any visitor to a defence exhibition who goes in search of what some opponents of the concept term 'killerbots' or 'slaughterbots' is likely to achieve little beyond the expenditure of time and shoe leather. During research for this article, the author looked at the specifications of more than 100 UGVs currently being marketed, or known to be under development, for which a combat role is claimed. None currently offer fully-autonomous capability.

Although there have been reports of autonomous robotic weapons being in service, these have never been confirmed. The Samsung SGR-A1 SENTRY System fixed-site installations deployed along the border between South Korea and the Demilitarised Zone that leads to North Korea has been reported by some sources as having an autonomous lethal capability, but this has been denied by its developer. While its surveillance system has autonomous functionality, the SGR-A1 cannot automatically fire, a company spokesman has stated.

On 27 November 2020, Brigadier General Mohsen Fakhrazadeh Mahabadi of Iran's Islamic Revolutionary Guard Corps was assassinated in a road ambush in Absard, a town around 70 km east of Tehran. An academic physicist, and by then a senior official in Iran's nuclear programme, he had been travelling in a car that was accompanied by three further vehicles and a reported total of eleven bodyguards.

Initial accounts of the killing claimed that it had been the work of a team of around a dozen armed assailants, several of whom had been killed in a shootout with Fakhrazadeh's bodyguards. Subsequent reports claimed that a remote-controlled weapon mounted in a parked Nissan truck had fired several bursts from a range of 150 m, hitting Fakhrazadeh several times. The truck also carried an explosive charge, which subsequently detonated in order to destroy the hardware used for the attack.

Iran claimed that the gun had been operated via a satellite-based datalink, but some reports suggested that the lethal weapon had operated autonomously, and had used facial-recognition technology to locate and identify its victim.

A 2019 publication Digital Infantry Battlefield Solution - part 3 by Milrem Robotics noted that, "The technology for fully autonomous UGVs currently remains immature. UGVs rely on machine learning, GPS, radar, and a human interface of some kind to assign tasks to the device." The main challenge faced by UGV designers was that of increasing the autonomy of future systems, and improving their ability to work as part of a team, it noted. Other necessary developments would include improved energy storage and expenditure, and better communications, while creating an effective ability to perform acceptably under complex conditions was seen as posing a challenge, particularly in urban warfare where the physical appearance and behaviour of enemy combatants may be hard to predict.

Command and control of ground forces that may include thousands of autonomous UGVs will not be easy, particularly when small unmanned air systems are added to the equation. In a fast-moving ground action, control of a UGV might have to be passed from the originating unit to a different unit that urgently requires support, or is in a position from which it can make better use of the UGV's services.

If used in large numbers, robotic vehicles will have to interact with each other and with human soldiers. Robots and soldiers will have to train together, with each learning how the other reacts in combat, then modifying their own behaviour in order to produce the best outcome. ■





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# Russia and the Lightweight Fighter Sweepstakes

Reuben F. Johnson

Russia's aerospace industry frequently uses the biennial Moscow Aviation and Space Salon (MAKS) as the occasion to make bold announcements about new developments in combat aviation. MAKS, which took place in July this year, had very little in the way of new innovations to trot out in front of the international media, but one of the few surprises was the announcement of a new, single-engine lightweight fighter prototype.

Designated as the Sukhoi Su-75 and wearing the moniker of CHECKMATE, this proposed aeroplane is the culmination of more than two decades worth of on-again and off-again Russian design studies for a small, affordable analogue to today's US Lockheed Martin F-35. Only some very basic data on the Su-75 design were presented at the Moscow expo on 20 July by the General Director of OAK, Yuri Slyusar, and the Su-75 Sukhoi Design Bureau chief designer, Aleksei Bulatov, but in the month since this original briefing more details have emerged.

The aircraft presented at MAKS, which was originally unveiled as a "prototype", is reportedly only a non-flying "hybrid" vehicle that is part prototype and part mock-up. The fact that there is not yet a complete pre-production prototype is indicative of the true status of the programme – as well as shining a light on the fact that the timelines given during last month's presentation are unrealistically optimistic.

## Author

**Reuben F. Johnson** is a 30-year veteran of reporting on the defence sector and analysing political-military affairs in the former USSR and Eastern Europe, the PRC and SE Asia and Latin America. His articles have appeared frequently in US, European and Asian defence and public affairs journals and he is also a long-time consultant to the Department of Defense. He is based in Kiev, Ukraine where he has covered both the 2004-2005 Orange Revolution and the 2013-2014 Maidan Revolution.



Photos and Caption: Yuri Laskin

**According to Aleksandr Mikheev, Rosoboronexport CEO, a number of international partners have stressed their interest in the newest CHECKMATE light tactical aircraft.**

Slyusar and Bulatov stated that the Su-75 would make its first test flight in two years and that the programme could be in series-production within four years, but numerous Russian industry sources claim this is wildly optimistic. If a first flight were to take place within two years, it is likely to be with a single-installation of the Saturn/Lyulka AL-41F1-series/117S engine that powers the Su-35 and early-production versions of the Su-57.

## Technology Barriers

A production version of the aircraft could only appear within five to seven years, say the same sources, and the Su-75 ever becoming a live programme with an actual customer depends on several parallel activities also proceeding according to plan:

- The Su-75 is designed to be powered by the same 5th generation fighter engine (known as IZDELIYE 30 in its design bureau designation) that is in flight test now

for the Su-57 programme. The prototype engine and much of the initial production technology are both being developed at the Ufa Motor-Building Production Association (UMPO). Representatives of the plant stated several years ago that they had made progress on developing next-generation single-crystal blades for this engine, but there is not yet a firm date for completion of the design's validation and an initiation of full-scale production.

- Another key component that has been stated as being part of the aircraft's equipment set is a new active electronically scanning array (AESA) radar. This would presumably be a derivative of the Su-57's NIIP N036 BYELKA radar, but that programme's status is still unclear. Reports from Russian industry are that this design suffers from Russian industry's difficulties with producing reliable and efficient transmit/receive modules (TRM). "The acceptable efficiency rating for an AESA that is equipped with Gal-



lium Arsenide (GaAs)-based TRMs is in the range of 40 per cent, but Russia's defence electronics sector has had trouble meeting those performance numbers," said a Ukrainian defence industry official.

- This radar set and other on-board systems for the Su-75 would depend on Russian industry now being able to produce new-generation electronic components on its own or sourcing those components from another non-US technology-based foreign firm. Sanctions imposed on Russia by the US have had a crippling effect on several areas of the aerospace sector. These sanctions block Russian purchase of both US-made new generation chips, as well as chips made in third nations that were produced with US production technology. This bars Russia from sourcing from traditional chip suppliers like the Republic of China (ROC) on Taiwan.

These are all significant technological bottlenecks that need to be overcome and the signs are not hopeful at present. Russian industry, which had already been experiencing a lack of experienced personnel in the electronics sector, has been hard hit by the Wuhan WIV-engineered COVID virus. Some key personnel have died from the illness and several others have recovered from the illness but are reportedly suffering severe aftereffects.

## Bait and Switch

Beyond these technological difficulties, Russian industry has need of a "hook" to try and convince potential customers that this aircraft is like the F-35 in that it is a derivative of the Su-57 in the same manner that the American single-engine jet borrows some of its design techniques from the F-22A.

"Even the designator of 'Su-75' was given to the aircraft as a PR gimmick," said one Russian industry expert. "Taking the Su-57's designator and just reversing the numbers creates the impression that these two aircraft are borne from one and the same [Sukhoi] design team."

In reality, the aircraft that today is labelled as Su-75 was actually a series of Mikoyan design studies for many years now. The most recent iteration of these Mikoyan single-engine fighter concepts dates back to before 2014, when that design bureau decided to develop a lightweight aircraft based on what was learned from the development of the MiG Project 1.42 Multi-Role Fighter (MFI) prototype.

This was the proposed project that was originally pitched to potential export customers in 2017. Even as late as the

end of 2020 the programme was being identified by the General Director of Rostec, Sergei Chemezov, as a Mikoyan design. (Chemezov is a long-time associate of Vladimir Putin and like the Russian President was also a former fellow KGB officer. Chemezov's Rostec holding company controls much of Russia's defence industrial sector.)



***The CHECKMATE presentation in front of Russian President Putin took place on 20 July 2021. It was followed by an enormous row of foreign delegations which made the CHECKMATE pavilion the busiest one at MAKS-2021.***

## Target Customers

Chemezov and Slyusar have several nations in mind as the most promising customers for the Su-75, with the key partner being the United Arab Emirates (UAE). This programme had been pitched to the Emiratis several years ago as a design that the two countries could develop jointly. The Gulf state had been inclined to consider a defence industrial partnership with Russia up to the point where the US agreed to sell the F-35 to the UAE. However, Russia now sees some daylight between Abu Dhabi and Washington due to growing ties between the Emirates armed forces and the People's Liberation Army (PLA). This includes what looks increasingly like a PRC military base being constructed in the UAE, which the US say could cause the F-35 sale to be cancelled if the base is completed.

Other potential customers that OAK and Rostec see as in the market for an aeroplane of this kind are India, Vietnam and Argentina. These countries all three need a new fighter that is easy to maintain and economical to acquire in the first place. In

the case of the first two, already operating other Russian-design aircraft makes the Su-75 a logical fit for their maintenance and logistics system.

(These are three nations, incidentally, that have also been looked upon as long-term prospects for the Saab JAS-39E/F and the aircraft would likely come off the production line operated by Embraer in Brazil.)

But what is the main point of scepticism is that the Russian entities responsible for the Su-75 programme have announced a target price for the Su-75 that is not viewed as credible. The target price, according to the presentation given by Slyusar was "US\$25-30M per unit", which is less than 20 per cent of the price of the F-35.

"There is probably not an air force in the world that this aircraft could be supplied so cheaply," said the Russian industry expert. This is really a fantasy being spun on the part of OAK and other senior industry leaders and there is no chance that this will be the final price to own one of these Su-75 – assuming it ever even gets built. Another hurdle, points out more than one combat aviation specialist, is that the Su-75 is also not a programme of record. As of now it has no financial support from the Russian Aerospace Forces (VKS), which also have no interest in procuring the aircraft. Until the Russian military decides to make this one of the weapon systems in their inventory, this programme is going to be a hard sell to almost any customer. ■

# Developments in the Global Sonar Market

**Bob Nugent**

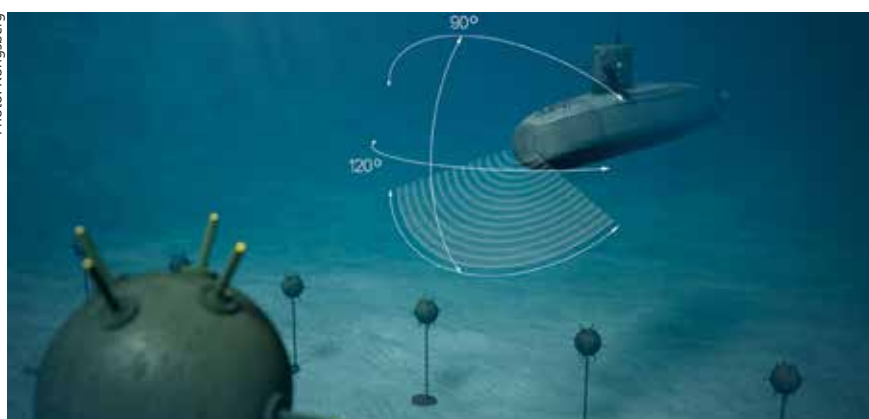
This article reviews current and future developments in the field of naval sonar, with specific focus on sonar markets, drawing on proprietary data from naval market experts AMI International. It begins by looking at the current state of sonar fit in the world's naval forces, presenting information on the four main types of naval sonar: hull-mounted, towed array, variable depth, and flank array.

Next, the article examines prospects for the naval sonar market in the coming two decades, using AMI's detailed forecast of future markets for ship and submarine-mounted sonars. Finally, it reviews recent technological, operational and acquisition developments in naval sonar that suggest how this key naval capability will further evolve in its second century of service.

## Introduction

It has been just over 100 years since the sonar became practical as a remote sensing device for naval operations. Sonar remains a primary means to detect and localize underwater objects of tactical interest—most prominently submarines. The state of the sonar art has accelerated in the last two decades with technological advances in two main areas—information technology for signal processing, and materials science affecting most components of sonar systems. Taken together, these technology drivers have increased the effectiveness and reduced the size, weight, power and cost of sonar systems. These technological advances in sonar systems come at time when the options for platforms to deploy sonars are expanding. Notably, unmanned maritime

Photo: Kongsberg



**Kongsberg's hull-mounted active mine detection and avoidance sonar for submarines. The sonar is capable of detecting bottom mines, moored mines and floating mines, as well as other objects.**

systems (surface and underwater vessels) are emerging as more effective and longer range platforms with sufficient space and power to mount some sonar sets. Equipped with better sonars, USVs and UUVs promise to further complicate the already challenging business of operating submarines at sea undetected.

## Current Market Scope – Ships in Service

The AMI Existing Ships Data Base (ESDB) identifies almost 4000 sonars now in service in all navies around the world. The four different sonar types installed on ships or submarines now in service are hull, towed,

variable depth, and flank (submarine).

Breaking down the percentages for all sonar shows that the hull type is most numerous, representing almost 60% of all types of sonars (2348 of 3990 sets) on ships and submarines now in service (all ages). Towed array types are next most common, making up over 20% (819 of 3990 sets).

A look at the current fit for the most modern ships and submarines, those commissioned since 2000, shows 1,462 sonars in service, or 36% of total world naval inventory. This suggests that, with over 2/3s of current sonar on ships and submarines over 20 years old, modernization will only grow in importance when looking at market activity for sonar systems.

## Author

**Bob Nugent** is a recently-selected Scholar Practitioner Fellow and Instructor at the Busch School of Business at Catholic University of America, (Washington D.C.), as well as Ph.D candidate in Strategy and Management at Virginia Polytechnic University. He continues to work as a consultant and writer/commentator in the Aerospace and Defense industry, affiliated with AMI International. He is a retired naval officer.

Ships with	Ships Commissioned		Ships Commissioned	
	All Years	%	2000-2021	%
<b>Hull</b>	2348	58.85%	824	35.10%
<b>Towed</b>	819	20.53%	363	44.30%
<b>VDS</b>	592	14.84%	157	26.50%
<b>Flank</b>	231	5.79%	118	51.10%
<b>Total</b>	<b>3990</b>		<b>1462</b>	<b>36.6%</b>



	Region-All	Commissioned 2000-2021							
	Asia-Aus	NATO	Non NATO Eur	US	Russia	MENA	Carib/Lat Am	Sub Sah Africa	Total
<b>Hull</b>	416	167	7	80	59	65	15	15	824
<b>%</b>	50.5%	20.3%	0.8%	9.7%	7.2%	7.9%	1.8%	1.8%	100.0%
<b>Towed</b>	176	71	3	74	25	11	3	0	363
<b>%</b>	48.5%	19.6%	0.8%	20.4%	6.9%	3.0%	0.8%		100.0%

Name	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Sonar Hull	75	81	73	88	94	89	89	77	76	67	52	42	45	38	36	29	28	16	17	12
YDS Sonar	19	25	20	32	26	34	35	30	25	14	9	13	8	12	7	5	3	5	3	3
Sonar Towed Array	32	34	31	37	39	34	43	35	39	37	30	24	24	21	23	21	21	15	15	11

Another observation is that towed sonars are more numerous than hull sonars on more modern ships as a percentage (44% compared to 35%). This highlights the development of towed arrays as especially suited for detecting modern submarines at extended ranges. As noted above, the growth in towed array systems has been aided by reductions in their size and weight, and improvements in signal processing.

The chart above provides a regional assessment of the existing sonar market on ships commissioned since 2000. The Asia Pacific region has the largest share of the current hull and towed array segments, reflecting the more general increase in naval spending on new ships in the area over the past two decades. About 50% of all hull and towed sonars globally are equipping Asia-Pacific navies. NATO navies (excluding the US) and the US Navy remain heavily invested in sonar ca-

pability, with the two areas accounting for between 30-40% of hull and towed sonar worldwide. The other regions of the world make up the difference, with Russia and the MENA region leading the rest of the table. The paucity of sonar equipment in navies of the Caribbean/Latin America and Sub-Saharan Africa regions is explained both by the more limited numbers of submarine targets found in those regions, and constraints on overall naval ship-building budgets.

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Sonar Type	2021	2022	2023	2024	2025	20 yr Total	20 year %
Sonar Hull	75	81	73	88	94	1124	55.7%
VDS Sonar	19	25	20	32	26	328	16.3%
Sonar Towed Array	32	34	31	37	39	566	28.0%
<b>Total</b>	<b>126</b>	<b>140</b>	<b>124</b>	<b>157</b>	<b>159</b>	<b>2018</b>	
<b>Annual %</b>	<b>6.24%</b>	<b>6.94%</b>	<b>6.14%</b>	<b>7.78%</b>	<b>7.88%</b>		
<b>5 year % of 20 years</b>					<b>34.99%</b>		

Hull Sonar	For Ships Commissioned 2000-2021		
Supplier	Number of Sonar Sets	% of 576	% of 824
Thales	144	25.00%	17.50%
ATLAS	105	18.23%	12.70%
Raytheon	98	17.01%	11.90%
SIMRAD (now Kongsberg)	65	11.28%	7.90%
Lockheed Martin	52	9.03%	6.30%
Kongsberg	33	5.73%	4.00%
BEL (India)	27	4.69%	3.30%
NEC/Mitsubishi (Japan)	20	3.47%	2.40%
BAE	14	2.43%	1.70%
L-3/Nautik (now Wärtsilä ELAC Nautik)	9	1.56%	1.10%
Ultra	9	1.56%	1.10%

## Future Market Scope

AMI's World Naval Projections Report (WN-PR) forecasts new naval ship and submarine construction worldwide through 2041. This two-decade forecast segments the sonar market into the same three types of systems: hull, variable depth and towed array. Hull-mounted sonar on both surface ships and submarines are the most numerous in the forecast, with over 1100 systems of that type projected to be acquired. This represents just over half of the future market for the 20 years period, with variable depth and towed array sonars combined making up the other 45% of the market. Since more than one sonar can be fitted to a ship or submarine, the 1100 sonars in the table above represent installation on a fewer number of ships. Ship construction contracts, and their system fits, are concentrated in the nearest 5 years period out to 2026. This pattern helps explain why future sonar acquisitions in the data are "front-loaded," with about 35% of forecasted sonar acquisitions found in the 2021-2026 period. The chart below examines estimated future sonar buys for this period, and compares the percentages and trends for each of the three types to numbers for the 20-year period. The near term market forecast for sonars is representative of the longer term projec-

tions. Breakdowns by market subsegment in that five year period shows patterns similar to the 20-year forecast: just over 50% of the near-term market is for hull-mounted sonars, just under 30% for towed arrays, and close to 20% for variable depth sonar.

## Supplier Positions

The sonar market features a number of highly effective and competitive offerors. The chart on the next page shows the relative market position of US, European, Japanese and Indian manufacturers of hull sonars equipping ships now in service (the 824 sets equipping platforms commissioned since 2000-highlighted in yellow). Taken together, the companies indicated make up about 70% of all hull sonar types now operating. Additionally, Chinese and Russian sonar producers remain the primary source for new hull sonar in those navies, which also represent sizable numbers of sonars going to sea. Germany's Atlas Elektronik and French-Dutch Thales are the leading manufacturers of sonar on the European side of the market, representing 18% and 25% (respectively) of the market represented by 576 sonar sets equipping navies outside Russia, China and other non-addressable markets such as Iran and North Korea. Norway's Kongsberg (in-

cluding ex-Simrad) British companies BAE and Ultra also make up a notable part of this market segment. On the US side, Lockheed Martin and Raytheon Technologies have the strongest position in the US market. Both European and US companies also compete effectively in the sonar export market.

## Recent Developments

As noted above, the joining of sonar and unmanned maritime platforms offers budget-constrained navies some promising alternatives in fielding more effective anti-submarine warfare systems. As noted in a recent US Naval Institute article, NATO's Centre for Maritime Research and Experimentation continues to organise exercises and tests of this approach. Exercises such as the DYNAMIC MANTA event continue to offer a venue for novel combinations of new sonar and unmanned host platform capabilities. While the unmanned platform is not likely to replace manned multi-mission surface combatants or submarines as the leading choice for new sonar deployments, they promise to contribute to the ASW mission (and anti-mine or other barrier defense applications of sonar).

Deployment of sonar in fixed acoustic arrays linked to the shore is another proven operational configuration being tested for new sonars. The US Navy's Office of Naval Research is seeking solutions for the Affordable Mobile Anti-Submarine Warfare Surveillance System (AMASS). The goal of the programme is to field "persistent, deep water, active ASW [anti-submarine warfare] system that can detect new emerging threat submarines at extended ranges."

The Naval Research Lab is also exploring low-frequency broadband (LFBB), an active sonar using advanced synthetic aperture processing drawing on advances in artificial intelligence (AI). The ability to extract even more tactically and operationally significant information from low frequency returns using advanced information technologies will prove critical for detection and classification of submarine targets.

Existing sonars are also seeing investments to upgrade their performance. Pennsylvania State University's Applied Research Laboratory is working with the U.S. Navy's Surface Warfare Centers in Crane, Indiana and Newport, R.I. in areas that include sonar development. Tests include the work on the TR-343 transducer, a core component of the AN/SQQ-89(V) undersea warfare combat platform now equipping US Navy DDG-51 destroyers. This work is taking place under a 10-year US\$2.1Bn contract awarded in 2018. ■



# Stealth Technology in Naval Shipbuilding

**Thomas Withington**

Stealth technology is traditionally associated with airpower but it is just as relevant to the maritime domain. Naval architects continue to refine their approaches to reducing a ship's radar cross section.

Warships make a racket in the electromagnetic spectrum. They generate sound. This emanates from their engines, propellers and other machinery. This can be mitigated by placing machinery on shock absorbers. Ships also emit Radio Frequency (RF) energy from their myriad of radars and radios. This is mitigated by using low probability of detection/interception waveforms for their radios and radars. These systems can also be momentarily deactivated to cease all RF transmissions from the ship. However, the ship will not be able to use these systems while they are switched off. A warship is visible to the eye and conventional optronics. Thermal radiation caused by things like a ship's exhaust allow her to be detected with infrared. Finally, the ship's physical bulk is visible to radar. This visibility is referred to as her Radar Cross Section (RCS). The RCS is what the radar 'sees' when radar transmissions hit the ship and are reflected to the radar's antenna as echoes. As in the visual domain make an object smaller and it becomes harder for the radar to see.

## RCS Reduction

A ship's RCS size is proportionate to her size and shape. Warships are large and typically festooned with a myriad of protrusions. Masts, antennas, weapons, superstructure, in fact anything that is above the waterline are manna from heaven for radars. They have surfaces upon which radar signals can echo back towards the transmitting radar's antenna. These echoes will betray details of the ships' size, speed and bearing. This is invaluable information for an attack. Understandably, there is an imperative to reduce a warship's visibility to radar. This is achieved



Photos: Thomas Withington

**The French Navy's ACONIT frigate belongs to the LA FAYETTE class. These ships were among the first surface combatants to make extensive use of RCS reduction techniques.**

through RCS reduction: "The main goal of RCS reduction is to reflect incoming radar waves in another direction away from the transmitting antenna," says Hervé Boy, Naval Group's senior business development manager.

Military aviation is perhaps the most famous application of RCS reduction technology. Low RCS, or so-called 'stealth' airframes, are de rigueur for combat aircraft. The US Air Force led the way introducing the world's first operational stealth combat aircraft, the Lockheed Martin F-117A NIGHTHAWK, in 1983. The naval world too has embraced low RCS design. Most surface combatants now employ RCS reduction techniques to greater or lesser degrees. Two of the most noticeable examples include the Svenska Marinen (Royal Swedish Navy) VISBY class corvettes and the US Navy's ZUMWALT class destroyer. Media reports in 2014 spoke of the ZUMWALT class being 40 % larger than the US Navy's ARLEIGH BURKE class destroyers. At the same time, the class has an RCS equivalent to that of a small fishing boat.

Reducing a warship's RCS rests on shaping the ship's superstructure so as to reflect incoming radar signals away from the radar antenna. A radar transmits a pulse of RF energy at the speed of light. This pulse collides with an object and is reflected as an echo to the radar. The radar measures the time for a pulse's round trip from the antenna to the target and back again. By halving this, the radar can determine the target's range. The radar will also determine whether the target is moving. This is done by calculating whether the frequency of the echo is higher or lower than the frequency of the transmitted pulse. Think of a radar pulse as a tennis ball. If you drop the ball onto the floor beneath you, it will bounce back to your hands. If you drop the ball onto an angled surface it will bounce away from you.

Low RCS ship design follows the same principle. The imperative when designing a low RCS warship is ensuring that the superstructure has surfaces angled to avoid transmitting echoes back to the radar. This typically embraces the use of flat, angular surfaces rather than curves. Curves are

## Author

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problematic. This is because at least one point on the curve will reflect directly back to the radar.

## Radar Absorbent Materials

Radar Absorbing Materials (RAMs) can be employed in conjunction with angled surfaces. Some materials reflect radar transmissions better than others. RAMs work by getting the material to absorb as much of the radar signal as possible, returning as little as possible back to the antenna.

The characteristics and behaviour of RAMs would warrant its own article. In the air domain, these have typically focused on

aircraft. Such radars tend to use relatively high radar transmission frequencies of X-band (8.5 gigahertz/GHz to 10.68GHz) and above. These frequencies have wavelengths short enough to precisely track a target. This is vital when guiding weapons to their aimpoint. Although used extensively in military aviation, RAMs are employed in warship superstructures to help reduce RCS.

## Countermeasures

A 1994 academic article in the US Navy's Naval War College Review by Captain John McGillvray entitled 'Stealth Technology in

dipoles are thrown into the atmosphere, then the radar will perceive these as thousands of targets. Although the target is still there, it is now masked by a dandruff of interference. For a warship, RCS reduction needs to make the vessel's RCS smaller than that of the chaff cloud. This will make the chaff cloud a more appealing target to the radar than the ship.

## Holistic Approach

As naval architects will attest, a holistic approach must be taken when reducing a ship's RCS. This begins with ensuring that every component above the waterline has as low an RCS as possible. Everything from gun mounts to antennas, deck lockers and helicopter hangers will have a radar cross section. The RCS of each of these must be reduced as much as possible. Just one deck component without a low RCS can render other RCS reduction efforts redundant. Mr. Boy calls this a "flashlight effect" where one component can strongly reflect a radar signal and risk betraying the ship.

One can observe in sleek designs like the VISBY and ZUMWALT classes the efforts taken to reduce the amount of superstructure clutter. Capt. McGillvray's article says that even a trash can or bucket left unobscured on the deck can reflect significant RF energy back to the radar: "We are masking all the outside equipment as much as possible," says Mr. Boy. For example, rigid inflatable boats routinely used for boarding operations are kept behind steel doors. These doors are designed to close flush to the superstructure. This ensures that gaps between the doors and superstructure cannot reflect echoes to the radar. Mr. Boy adds that similar approaches must be taken for every external system and fitting on the superstructure.

The trend towards the adoption of integrated masts over the last two decades highlights this approach. Integrated masts package a ship's radars, communications, electronic warfare and optronic sensors in one structure. This eliminates the need for separate housings for these systems. The integrated mast can be appropriately designed and use RAMs to help reduce a ship's RCS.

RCS reduction techniques do not make a warship invisible to radar. Instead, they make her harder to detect. One source shared an illustrative anecdote with the author. They were serving as the captain of a large surface combatant in a NATO navy. The ship was approaching port and preparing to receive a pilot. The pilot's boat was equipped with a standard marine navigation radar. The pilot radioed the warship to ask for their



**Radar echoes produced by structures like missile launchers have led to such systems being recessed in a ship's hull to help reduce RCS.**

polymer-style materials covering the surfaces of low RCS aircraft. These materials will include ferrite or carbonyl iron coated minute metal spheres. These spheres are suspended in an epoxy paint. Ferrite and carbonyl are two examples of many RAM materials and techniques. When the radar transmissions hit the paint, they cause the spheres to vibrate. These vibrations create heat which then dissipates as it is released. The paint receives the radar energy and converts it into heat, rather than returning it back to the radar. The aircraft's airframe acts as a heat sink by absorbing the tiny rise in temperature this process causes.

RAMs are not a cure all. They cannot absorb all radar frequencies, but they can be effective against radar transmissions in specific frequency bands. In the air domain, RCS reduction will be dictated by the radar transmissions most likely to threaten the aircraft. These will almost certainly be fire control and weapons guidance radars used to track a target and guide ordnance to the

Surface Warships' stated that ship RCS reduction does not exist in a vacuum. It works with other self-protection techniques like chaff. Chaff is the collective noun for the thousands of dipoles dispersed into the atmosphere to outfox an incoming radar-guided anti-ship missile. A dipole is a thin piece of metal or glass fibre cut to precisely half or one-quarter of the wavelength of the radar frequency it is jam. For example, an X-band frequency of 8.5GHz will have a wavelength of 35.2mm. Half this wavelength is 17.6mm. Chaff dipoles would need to be this length to jam a radar transmitting on 8.5GHz. This would ensure the radar's transmissions would be reflected by the chaff as echoes.

A radar signal will hit the dipole. This will make the dipole resonate. As the radar waves keep hitting the dipole, the resonance will continue. These resonances are returned to the radar as echoes. The echoes are detected by the radar which will perceive them as targets. If thousands of





**The low RCS design of the Royal Swedish Navy's VISBY class corvettes is representative of the trend for reducing the RCS of comparatively smaller surface combatants.**



**Integrated masts like that equipping the Argentine Navy's ARA BOUCHARD OPV are a major step forward in helping reduce the RCS of a ship's superstructure.**

location as the only vessels their radar could detect were trawlers. RCS reduction techniques had provided the warship with an

RCS equivalent to a small fishing boat. The ship was able to 'hide' amongst the large number of trawlers out at sea that night.

Furthermore, it might not be necessary to design a warship to present a low RCS to every radar she may encounter. The wide range of frequencies and radar transmissions in this section of the radio spectrum could make such an approach nigh-on impossible. Instead, a ship's RCS may be configured to ensure she presents a low RCS to the frequencies most likely to be used by naval surveillance radars for detection. Such radars typically transmit in S-band (2.3GHz to 2.5GHz/2.7GHz to 3.7GHz) and C-band (5.25GHz to 5.925GHz). She will also be configured to present a low RCS to fire control radars. These typically transmit on frequencies of X-band and above. Computer Aided Design (CAD) has helped immeasurably in RCS reduction. Every part of the superstructure is measured to ascertain its radar cross section: "After measuring the RCS of each of these components, we add these to the global RCS of the ship," observes Mr. Boy. "This gives us a complete RCS measurement of the vessel." He adds that RCS reduction is factored into the ship's design from the outset well before the first piece of steel is cut. In addition to CAD approaches to RCS reduction, the radar cross sections of components can be measured in anechoic chambers. Dockside systems can also be used to measure the ship's overall RCS during construction.

### Shape Shifters

Since debuting with the French Navy's LA FAYETTE class frigates in the mid-1990s, RCS reduction techniques have proliferated around the world. To date, they have mainly been used for frigate and destroyer-sized combatants. As shown by Sweden's VISBY class, this technology is migrating to smaller ships like corvettes. Over coming decades, RCS reduction techniques may be adopted by Offshore Patrol Vessel (OPV) sized ships or amphibious assault platforms. The Argentine Navy's BOUCHARD GOWIND class OPV is indicative of this trend.

Mr. Boy says that RCS reduction is one of Naval Group's main research and development activities. He notes that the company is looking at ways to change as well as lower a ship's RCS. This could be useful in making the vessel appear as a different type of ship altogether. For example, a frigate could have her RCS altered so she appears to have a similar RCS to a ferry. Mr. Boy believes that this approach could be possible in the future using avantgarde materials. These maybe able to modify their shape and physically alter a warship's appearance to create the desired RCS. ■



## Viewpoint from New Delhi



Photo: Suman Sharma

### Taliban Returns, Kabul Falls

**Suman Sharma**

US Navy Adm (Ret'd) James G. Stavridis once said, "Some have called Afghanistan 'the graveyard of empires,' and it probably is the graveyard of empires." Kabul fell on 15 August to the Taliban within weeks of taking over 70 % of Afghanistan as the Ashraf Ghani Government collapsed. The US left behind US\$20Bn worth of sophisticated, modern and deadly military hardware and equipment in the hands of the barbaric, mediaeval terrorists now in control of the war-torn country.

The Taliban onslaught, which started on 1 May (the date set for commencement of the withdrawal as per the Trump-Taliban Doha peace deal of February 2020), only increased following the exit of the US-led NATO troops from the largest US military base in Afghanistan at Bagram in early July, after which the Taliban took over Ghazni province following a brutal massacre of nine ethnic Hazara men. The actual inflection point came with the takeover of Zaranj city in the first week of August. With Government troops surrendering with their equipment in many places and many provincial Governors handing over keys to the Taliban, it was a free run for the terror outfit to take capital after capital until they encircled Kabul. North Afghanistan was always considered to be the stronghold of anti-Taliban forces, with Mazar-e-Sharif one of the most anti-Taliban cities. With the fall of Mazar on 14 August, victory looked imminent for the Taliban.

As President Ghani fled the country to take refuge in the UAE, the Taliban seized the Presidential Palace, thereby plunging the nation into statelessness. The following is the list of military weapons and equipment handed over by the US to the Afghan National Defense and Security forces (ANDSF) which have been taken over by the Taliban, making them the world's first unrecognised State in possession of a military:

1. The Afghan Air Force (AAF) operated 45 UH-60 BLACK-HAWKS, 50 MD-530s, and Mi-24 helicopters (gifted by India) besides its A-29 SUPER TUCANO light attack fighters (23 in number), C-130 HERCULES transport aircraft, C-208 utility aircraft, and AC-208 fixed-wing aircraft.

In total, the AAF had an inventory of 211 air platforms of which 167 were operable as of 30 June.

2. High Mobility Multipurpose Wheeled Vehicles-M1151 and M1152 HUMVEEs, 270 Ford RANGER light trucks, 141 NAVISTAR INTERNATIONAL 7000 medium trucks.
3. M4 carbine and M16 rifles.
4. There are reports about ammunition being left behind which includes around 10 thousand 2.75 inch high-explosive rockets, 61 thousand 1.57 inch calibre high explosive rounds, one million rounds of 1.97 inch calibre ammunition, and more than two million rounds of 0.3 inch bullets.
5. There were also 11 bases and military complexes handed over to the ANDSF recently, now all under Taliban control.

The Biden Administration has come under severe criticism for the abrupt exit of troops which has led to chaos and violence.

Photo: US Marine Corps



**US Marines and Norwegian coalition forces assist with security at an Evacuation Control Checkpoint ensuring evacuees are processed safely during an evacuation at Kabul Airport, on 20 Aug. 2021.**





Photo: US Air Force / Staff Sgt. Ryan Brooks

**The Pentagon sent reinforcements to Kabul to protect the US withdrawal from Afghanistan amidst volatile conditions at Kabul Airport. Depicted is a C-17 GLOBEMASTER transporting US Marines to Afghanistan from Ali Al Salem Air Base, Kuwait, on 18 August 2021.**

Despite assurances from the Taliban that no harm would come to foreigners, the US and other countries are now using Kabul airport to evacuate their citizens and also eligible and particularly vulnerable Afghan nationals by 31 August 31.

Though comparisons have been made between Taliban 2.0 and Taliban 1.0 (in power from 1996-2001), little seems to have changed. A more moderate side was on display by the Taliban spokesperson Zabihullah Mujahid in his maiden press conference on 16 August 16, but the very next day, Salima Mazari, one of the first women Governors in Afghanistan, was arrested by the militia. There are reports of assassinations and even of dismembering of citizens.

Jalalabad became the first province to protest against the forceful and illegal takeover of the country when the Taliban killed a man trying to hoist the Afghan national flag.

## The How and Why

US intelligence estimates gave Kabul 90 days, but this went horribly wrong when the world was stunned with the take-over of Kabul within hours, and no one could foresee the speed with which this happened. The Taliban overran the capital city in a single day without even a fight.

The cause of the debacle can be attributed to a host of reasons:

- Ethno-polarisation and infighting between various factions that led to the country becoming susceptible to foreign interference.
- Afghanistan used by the big powers for zero-sum Great Games. The 'flip-flopping' in US Afghan policy - be it the reduction of troops, constantly changing withdrawal timelines, cutting an unceremonious peace deal with the Taliban, and finally an abrupt and haphazard exit of troops without put-

ting a viable support system for the ANDSF in place.

- Supporting a pliant regime in Afghanistan that proved to be inept in nation building and inspiring a rudderless and weak ANDSF plagued by gross corruption which crumbled like a pack of cards in the face of the Taliban onslaught.
- Born out of the remnants of the Northern Alliance, the 300,000 strong Afghan Army, trained by the US for the past 20 years at an estimated cost of US\$4Bn a year, simply collapsed, and in places changed sides and joined the Taliban. The corruption, with reports of Afghan soldiers not being paid and the Taliban paying them pocket money, the lack of leadership, motivation and will to fight, being abandoned by their leaders and mentors and left on their own, all favoured the Taliban. The Afghan Army were never raised and trained to be a professional army, but functioned like a paramilitary force meant for counter-insurgency roles, relying heavily on US air power which started to decrease from 1 May onwards.

India was among the first to begin evacuating its nationals and diplomatic staff and there are around 3,000 Indians still in Afghanistan. Indian Army LtGen (Retd) BK Sharma says, "Presently, we have no diplomatic presence in Kabul. Pakistan and China will possibly try to capture that space. Our projects stand stymied, our people there are at dire risk. There is a strong likelihood of Afghan territory being used by India-centric terrorist groups. At the macro-level, the emerging Taliban-Pakistan-China-Russia – Iran strategic alignment will prove to be highly inimical to India's Eurasia outreach."

After a 20 year military mission, stained with bloodshed at an estimated cost of US\$3Tn, along with 2,500 soldiers lost in the war, the US left the country to the Taliban from whom they took it with the aim of ending terror, sending the lives of 38 million Afghans back to square one.

# Softkill Solutions for the Modern Navy

**Doug Richardson**

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

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

## SLQ-32

SLQ-32(V)3 was the first variant to add an active radar-jamming capability, and was installed on cruisers, battleships, large amphibious ships, and high-value replenishment vessels. Aircraft carriers were fitted with the SLQ-32(V)4, which consisted of two (V)3 systems (one on each side of the ship), and a common computer and display console. The EXOCET attack on the OLIVER HAZARD PERRY class frigate USS STARK in 1987 triggered the development of the SLQ-32(V)5, a more compact version of the (V)3 system that provides this class of warship with an active-jamming capability. Since the SLQ-32 had been designed in modular form, upgrades were easy to implement and were often conducted when a ship underwent major overhaul. So (V)1 systems were often modified to the (V)2 standard, and (V)2 versions could become (V)3.

## Author

Following an earlier career in engineering, **Doug Richardson** is a defence journalist specialising in topics such as aircraft, missiles, and military electronics.

Photo: USN



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

Photo: Lockheed Martin



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



## The SEWIP Programme

SLQ-32 was to have been replaced by the AN/SLY-2 Advanced Integrated Electronic Warfare System (AIEWS), but this programme was cancelled in 2002 due to over-runs in time and cost. It was replaced by the Surface Electronic Warfare Improvement Programme (SEWIP), which uses an open architecture in order to allow rapid integration of emerging technologies.

Block I (which is sub-divided into Blocks 1A, 1B1, 1B2, and 1B3) is intended to improve anti-ship missile defence, counter-targeting and counter-surveillance capabilities, as well as tackling hardware-obsolescence issues. It also adds Specific Emitter ID (SEI) and High Gain/High Sensitivity (HGHS) capabilities intended to provide improved situational awareness. HGHS is intended to provide better capability against low-probability-of-intercept signals. SEWIP Block 2 includes an upgraded antenna, a new digital receiver, and enhanced processing capabilities. The combination of Block 1B3 and Block 2 hardware creates the SLQ-32(V)6 standard, which entered service in 2014 on the DDG 51 Flight IIA destroyer USS BAINBRIDGE (DDG 96). It

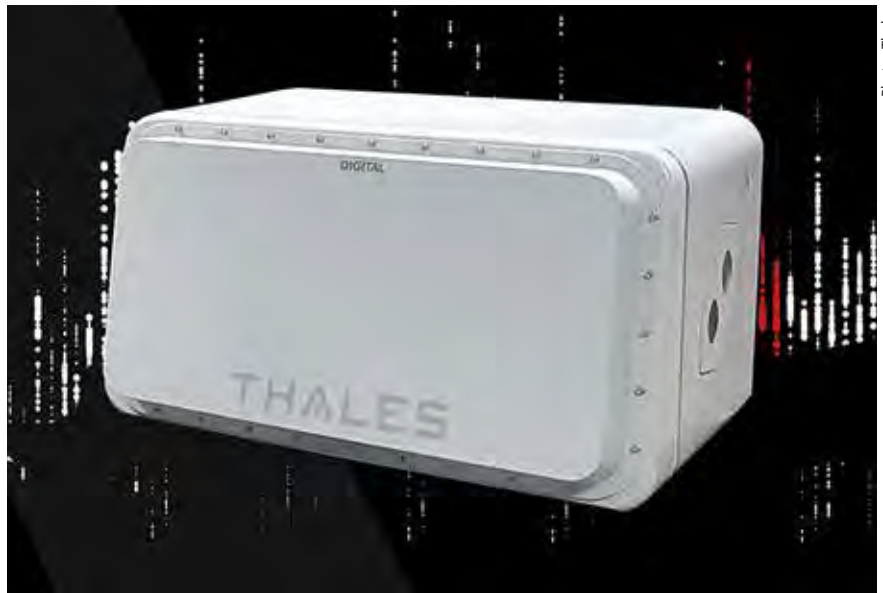


Photo: Thales

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

is now in service on a growing number of DDG-51 guided-missile destroyers, also on DDG-1000 destroyers and on large-deck amphibious ships. The planned CONSTELLATION class frigates will have two SLQ-32(V)6 Surface Electronic Warfare

Improvement Program (SEWIP) Block 2 systems. A compact SLQ-32(V)6C variant – also known as SEWIP Lite – was developed for use on the Littoral Combat Ship (LCS), but its first application was on a USCG Offshore Patrol Cutter.



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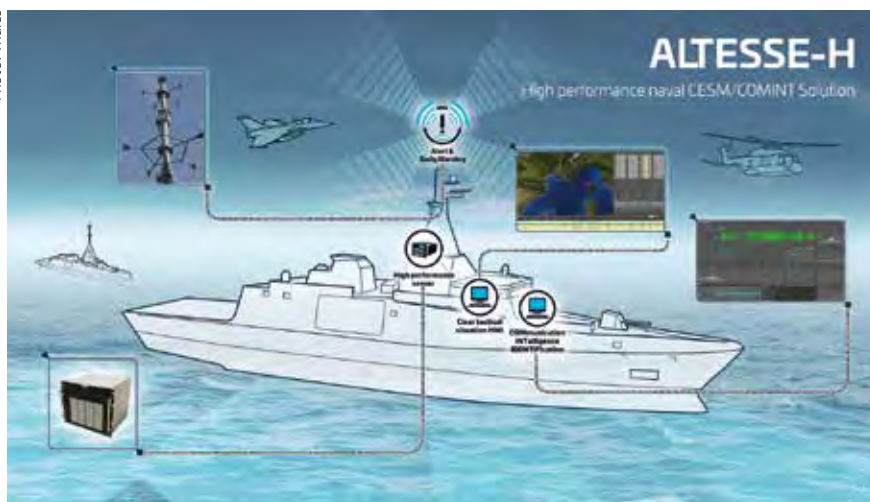
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Photo: Thales



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



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

Photo: Rosobornexport

SEWIP Block 3 provides improved Electronic Attack (EA) capability intended to keep pace with the evolving threat. A combination of the Block 1b, Block 2, and Block 3 will make up the SLQ-32(V)7 standard, which is earmarked for use on DDG-51 destroyers, NIMITZ and FORD class aircraft carriers, and WASP class amphibious assault ships.

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

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

The EW installation for the French Navy's planned class of five FDI (Defense and

Intervention Frigate) warships has not yet been fully defined. AMIRAL RONARC'H – the first of the new class – is due to be delivered by the end of 2023, and the final example by the end of the decade. Potential components for the EW suite include the Thales' SENTINEL ESM and EW system and ALTESSE-H Comint system, plus unspecified launchers for chaff, flares, and corner-reflector decoys.

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

## Russian Developments

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

Delays with production of GORSHKOV class led to the decision to build the ADMIRAL GRIGOROVICH class frigates. Their EW suite is reported to include the TK-25-5 ESM system and four KT-216 decoy launchers. A total of six frigates are planned, but only three are in service. Two of those currently fitting out have been assigned to the Indian Navy, and the third may share their fate.



Conceived as a cheap alternative to the ADMIRAL GRIGOROVICH class frigates, Russia's Project 22800 (KARAKURT class) missile corvette was announced in 2015. The first-of-class was launched in July 2017, and accepted into service in December 2018. Rosoboronexport is promoting the new class, but has released no information on its EW systems. Antennas for these are presumably contained in the ship's integrated mast.

## Chinese Systems

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

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

## The Multi Ammunition Softkill System

In April 2021, Rheinmetall announced the delivery of the 300th Multi Ammunition Softkill System (MASS). The customer was the Finnish Navy, which was also the system's first customer. Close to two decades after product launch, MASS is now in service with 14 navies. A typical installation consists of between one and six trainable launchers. The most recent variants are the MASS OCR with off-board corner reflector



Photo: Elbit

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

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

## The New Generation DAGAIE System

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

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

Photo: TCI



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

Photo: Lacroix



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

Photo: USN



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

## The NULKA

Developed by Australia and the US, the NULKA decoy is powered by a solid-propellant rocket. It is designed to hover, and to move away from the ship that launched it, maintaining a pre-programmed height and speed. Its payload is a broad-band RF repeater able to radiate a large radar-cross-section signal while the NULKA flying a trajectory that mimics the likely behaviour of a warship, thus presenting an attractive target to incoming missiles. In 2015, the USN carrier USS DWIGHT D EISENHOWER (CVN 69) successfully completed launch trials for the NULKA. Over a three-day period, the carrier used its

MK 53 decoy launching system (DLS) to launch the NULKA decoy five times.

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

A custom-designed NULKA munition adapter allows the munition to be quickly and cost-effectively inserted into an

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

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

## VESTA

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

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

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



# How Relevant are Rare Earths to Europe's Security and Defence?

Juan Manuel Chomon and Andreas Ganser

Rare earths are crucial to industrial components that surround us on a daily basis and are in any high-tech device. They are strategically relevant at national and international level.

**R**are materials are the new gold of modern society. China's former political leader Deng Xiaoping said in 1992: "The middle East has oil. China has rare earths". The concept of rare earths groups together 17 chemical elements, metals, from the periodic table. These elements, considered the vitamins of metals, make possible the characteristics of certain industrial components that surround us on a daily basis, especially many of those related to high technology.

## Rare Earths in the Defence Sector

In the defence sector, rare earths enable the development of more efficient, agile, and intelligent military capabilities and combat systems. Rare earths are now essential for night vision devices, precision guided weapon systems, communications equipment, navigation systems, batteries, stealth technology, drones, laser target designators and

## China's Monopoly on Rare Earths

China has strategically developed a monopoly on the rare earths market since the 1990s. Currently 80% of rare earth metals are produced in China. During 2010, as a result of a territorial dispute on the Japanese island of Senkaku, China suspended shipments of rare earths to Japan. More recently, in 2020, there was a direct threat from the Chinese Government to



Photo: author

*The conflict with Japan over the Senkaku Island led China in 2010 to impose export quotas on rare earths.*

These metals have a recognised strategic relevance at national and international level and play a fundamental role in the energy transformation towards renewable energies, in the medical sector, in the telecommunications sector and in general are essential and present in any high-tech device, including our mobile phones.

## Authors

**Maj. Andreas Ganser** of the German Air Force and **Lt.Col. Juan M. Chomón Pérez** of the Spanish Air Force are both students in the German Bundeswehr Command and Staff College.

communication satellites, to name but a few examples. Alloys, superalloys, and high-performance metals are also used in armoured vehicles and projectiles to make them hard and tough. These rare earth metals and alloys can be found in a stand-alone weapon system or as part of subsystems that form part of a more complex weapon system such as a frigate or fighter aircraft.

In short, it is safe to say that without rare earths, many of our high-performance weapon systems could not be produced. Potential disruptions in the rare earth supply chain would have a serious impact on the defence capabilities of any country with a technologically developed military.

three major US defence contractors. Its foreign ministry said it would sanction Lockheed Martin, Boeing and Raytheon for selling arms to Taiwan, the self-ruled island that Beijing claims as its sovereign territory.

This threat ultimately failed to materialise. However, a hypothetical projection of the threat towards Europe suggests that European companies that could indirectly endanger China's security could be sanctioned. These would be enterprises selling arms to any country or territory which China is in conflict with. They could be sanctioned with limitations or disruptions in their supply of rare earths.

One example, only theoretical, could be the French company Dassault Aviation.

Dassault, backed by the French Government, has produced the majority of French fighter aircraft from the second world war to the present day. Dassault sold 36 RAFALE fighter aircraft to India, which are currently under delivery, and plans to sell more in the future. In addition, on 7 June, Dassault signed an agreement to sell another 36 RAFALE aircraft to Indonesia.

## Geopolitical Tensions in the Indo-Pacific

China has been engaged in a border dispute with India for years. It also actively claims, through its fishing militia, part of Indonesia's Exclusive Economic Zone in the Natuna Sea, and at the end of 2019 there was an incident that led to military action.

Following the same logical line of argument that China threatened to sanction by cutting off the supply of rare earths to US companies on national security grounds, it could also target sanctions against Dassault and thus France for selling weaponry to countries that threaten its security or national interests.

Obviously, this example could be extended to other European weapon system manufacturers such as frigate manufacturers which have a growing presence in the Indo-Pacific. This presence in the Indo-Pacific region will possibly be increased in accordance with the 'EU Strategy for cooperation in the Indo-Pacific', published in April 2021. It states the EU's intention: "...to cooperate with

partners' navies, and build their capacities where relevant, to establish comprehensive monitoring of maritime security and freedom of navigation, according to international law."

Many modern frigates incorporate a total of more than 1.5 tonnes of rare earths but the case of the RAFALE is particularly significant as this aircraft can carry nuclear weapons, constituting, together with the strategic nuclear submarines, a fundamental vector in power projection and a cornerstone of the French national defence strategy based on nuclear deterrence. The dependence of this aircraft on critical materials, including rare earths, is noted. But the EU and its defence enterprises as Dassault are no exception. A Congressional Research Service report of the US said that each F-35 required 417 kg of rare-earth materials.

In its relationship with China and the US, the EU maintains a balancing act between its economic interests on the one hand and its moral values and Western foreign and defence policy on the other. Thus, while the EU's biggest trade agreement with China to date was signed in December 2020, sanctions against China, arising from its policy towards the Uyghurs minority in the Xinjiang region, were signed only with some months of difference. So far, sanctions have been limited by both sides to the diplomatic sphere without affecting the wider economy. However, as tensions rise, the EU is aligning itself with US foreign and security policy and sanctions could affect other areas such as rare earths and the defence sector.

## EU Reliance on Rare Earths

On the other hand, since 2020 the European Commission has officially recognised the dependence of its arms industry on rare earths. According to findings of the European Commission, entitled "European Critical Raw Materials for Strategic Technologies and Sectors" published in 2020.

As clearly stated in this report, rare earths are a key element in the development of EU weapons systems. In the case of the US, this dependence was identified earlier, as seen in the data provided by the National Defence Stockpile Center's in spring 2010.

European weapon arsenals are largely equipped with weapons systems sourced from our American allies. It is important to note that the US DoD possesses a small stockpile of rare earth metals, which the EU does not possess, and which would allow it to cope with certain supply shortages.

Throughout 2020, the United States, through its Department of Defense, took an initiative aimed directly at sustaining its defence industry through an assured supply of rare earths. Several contracts were awarded in this initiative to the Australian company Lynas Rare Earths Ltd., the largest Rare Earth element mining and processing company outside of China. The most important is the creation of a refinery in Texas, which focuses on undoing the bottleneck strategically created by China downstream in the production chain, precisely on the



**Lockheed Martin was threatened by the Chinese Government in 2019 with rare earths supply suspension.**



refining and manufacturing side in order to obtain the metals.

## 2025 – EU Rare Earths Shortage

The European Union has taken steps to try to secure industrial supplies of rare earths. The Action Plan on critical Raw Materials published in September 2020 includes a European Raw Materials Alliance to bring the main stakeholders (member states, industry, and investors) together and strengthen the EU strategic autonomy. Another focus of this Plan is the encouragement of the research and innovation sector to develop the substitution and recycling of rare earths. However, these measures leave the development of a supply chain in the hands of EU civilian companies of the mining and metallurgy sector.

So far, no specific measures have been produced aimed at securing the supply of rare earths to major European arms manufacturers. For instance, the strategic storage of raw materials, could be a main instrument to bridge a shortage induced by sanctions. Furthermore, the Action Plan reveals a long-term solution but doesn't provide with a sus-

tainably architecture to react to crises flexibly. Regardless of whether the European arms industry is exposed to sanctions by China, in the form of rare earth supply cuts, the more real danger is that a rare earth supply shortage will arrive from 2025 onwards, as the European Commission itself points out.

The demand for rare earths worldwide is so growing that China will not be able to supply all markets, possibly prioritising its own. A general lack of supply could have huge repercussions for national and international security, including the security of individuals, as virtually all our technological devices are equipped with them.

## Time to React

Developing a complete rare earth supply chain is not achieved in a year or two. A new mine normally takes a minimum of 5 years from the time it is planned, until it becomes operational. Perhaps the time has come for European governments and the EU to take stronger interventionist measures on the market of rare earths and not to leave the problem in the hands of the theoretically "efficient" market. Therefore, some actions must be taken to guar-



Photo: Dassault Aviation

## RAFALE fighter aircraft sold to India by France

antee the EU stability and open strategic autonomy as soon as possible:

1. Vertical integration of the value and supply chain of rare earths (and more widely of strategic raw materials) by the EU Commission or the EU nations governments, securing the provision for the defence sector with direct contracting and investment.
2. Governmental protection and support for development of key technologies of recycling and substitution.
3. Building strategic reserves, storing rare earths and other strategic raw materials to flank a predicted shortage.

The scarcity of rare earths is a subject that may at times appear to be purely economic and commercial, but it is essential for and could jeopardise the international security. Its relevance should not be underestimated. ■

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# Less-Lethal Enforcement Technology: Definition and Use

**Joris Verbeurgt**

Conventional weapons, from a simple knife to a sophisticated missile, are primarily designed to kill the enemy and to destroy his capabilities. By contrast, less-lethal technologies are devices designed to be less likely to cause death.

Less-lethal weapons are commonly used in policing and public order situations where the use of lethal force is either undesirable or prohibited. The military also occasionally employs less-lethal technology in situations where the rules of engagement necessitate minimum casualties or where the use of conventional force is restricted. In doing so, they try to minimise the risk of (lethal) casualties, although death and permanent injuries can never be excluded (hence the term, less-lethal weapons and not non-lethal weapons). In peacekeeping and operations undertaken to maintain stability, less-lethal weapons have proven to be very effective and to have a deterrent effect on the target. Non-lethal technology is often used for the purpose of self-defence, to channel the movement of people and to limit access to restricted areas. It is also very effective in controlling riots, prisoners, refugees and (domestic) crowds in general.

## Classical non-lethal technology

Some devices in the non-lethal weapons' arsenal are part of the standard equipment used by police services and (para) military forces and are used on a daily basis and therefore commonly known to the general public.

Examples of this include: the water cannon, tear gas (including pepper spray), rubber bullets and tasers.

### Water cannons

Water cannons are devices that shoot streams of water at high velocity and over a long distance at a group of people or individuals unwilling to comply. They originate from water cannons that were formerly used on fireboats shortly after the First World War. The cannons were later installed on fire trucks. The first use

Photos: via author / CC 3.0



*The use of a water cannon by the Berlin police in 2001.*

of a water cannon to disperse a crowd was in Germany in the early 1930s. Since then, police forces have used the water cannon to disperse crowds of people or to prevent them moving to certain positions. There's little risk of (lasting) harm, but the pressure of the water can still cause severe injuries to the eyes and, in the most extreme circumstances, cause death.

During The Troubles in Northern Ireland in the 1960s and 1970s, the police added pink dye to the water to make it easier to identify and arrest rioters later. The UK has abandoned that practice, but countries such as Korea, Indonesia and China (recently in Hong Kong) still make use of this simple but effective method to mark the protesters.

Modern water cannons are also capable of adding tear gas to the water and experiments are ongoing to conduct electricity through the water stream for the so-called 'electrified water cannon'. Portable water guns, with adjustable volumes of water, nozzle speed, pressure

and power of impact, are also in an experimental stage of development.

## Tear gas

Tear gas is a so-called 'lachrymator agent' ('lacrima' is the Latin word for 'tear'), a chemical agent that stimulates the nerves of the lacrimal gland in the eye to produce tears. After inhalation, it can cause severe eye and respiratory pain, skin irritation, bleeding and temporary blindness. In riot and crowd control situations, tear gas is launched by means of a grenade. The grenade then releases the gas in the middle of the crowd. When used for self-defence purposes or to bring a suspect under control, a specific type of tear gas known as 'pepper spray' is used: a temporarily disabling aerosol that is composed partly of capsaicin oleoresin (a derivative of cayenne pepper, hence the name) that causes irritation and blinding of the eyes and inflammation of the nose, throat, and skin. Pepper spray is often released through a spray can at a short distance from the target.



Although not meant to kill or to physically injure the target, tear gas and pepper spray may cause serious injuries and even death, be it from the grenade used to launch the tear gas or by the extreme suffocating effects of pepper spray. Recent research has indicated that the long-term effects of the inhalation of tear gas and pepper spray are not as innocent as they seem. Although tear gas is deployed for (domestic) riot control by law enforcement agencies and military personnel, its use in warfare is prohibited by various international treaties.

## Rubber bullets

Rubber bullets are also very popular among police and military forces for riot control and to disperse crowds. They were originally developed in the 1960s by the British Ministry of Defence to be used against protesters in Northern Ireland during The Troubles. They were first used in 1970. Although the name suggests that rubber bullets are made out of rubber, in reality, the bullet has a metal core with just a rubber coating around it. Its less-lethal effect also stems from the lower speed at which rubber bullets are fired. Rubber bullets come in all sorts of forms, but rubber has always been a minority component. Since rubber tends to bounce uncontrollably, rubber projectiles have largely been replaced by other materials, such as soft polymers, plastic and wax, but the term has survived. To incapacitate the target, rubber rounds rely on the transfer of kinetic energy to cause a very painful trauma at impact. Although they are far less lethal than full metal bullets, they can still cause serious injuries such as blindness, permanent disability and death, especially when the bullet is fired at the head of the victim at short range. To prevent fatal casualties, the first rubber bullets



*The use of a water cannon by the Berlin police in 2001.*

were designed to be fired at the ground and then hit the target with a ricochet effect. Other non-lethal bullets are supposed to be fired at the lower body in order to prevent (possibly lethal) head injuries.

Derived from the rubber bullet-concept are 'beanbag' rounds, consisting of a small fabric 'pillow' filled with lead and weighing about 40 grams. When fired, the bag is expelled at around 70 to 90 m per second. It spreads out in flight and distributes its impact over about six square centimetres of the target. It delivers a blow that causes minimum long-term trauma and no penetration, but that will result in a muscle spasm or other reaction to briefly render a violent suspect immobile. However, it can still cause serious injury and death.

More recently, high-velocity paintball guns are used to launch less-lethal rounds. Rubber bullets releasing an electroshock effect are also a recent invention. They release kinetic and electric energy at the same and are a combination of a rubber bullet and a taser.

## Tasers

Tasers are well-known electroshock weapons used for subduing a person by administering an electric shock that disrupts the su-

perficial muscle functions of the body. Some electroshock weapons administer an electric shock by direct contact (like stun guns and stun batons), but the most known is the taser, which fires projectiles that administer the shock through a thin, flexible wire. The taser was initially developed for use by civilian police, but is now also widely used within the US military and by private citizens in the US for self-defence purposes.

## New developments

In recent years, tensions have been rising all over the world: think of the Black Lives Matter riots in the US, the Yellow Vest protests in France and the (often violent) protests against the anti-COVID-measures all over the (mainly western) world. There have been severe riots in Myanmar, in the Republic of South Africa and also in Hong Kong against the usurpation of powers by Beijing. At Europe's borders, in Ceuta (a Spanish enclave in North Africa), in Hungary and in Greece, police forces often clash with large groups of migrants who try to illegally enter the European Union. The threats are high and real, but governments have become more aware of their reputation, at home and abroad, and have become more eager to prevent the use of lethal force if the same objective can be reached without having dead bodies shown on the evening news. They actively support the development of non-lethal weapons to provide a range of options between talking and shooting. As a consequence, police and military forces are looking for a broader range of less-lethal weapons that can be deployed against all kinds of troublemakers, that are more life-conserving, environmentally friendly and cost-effective. Business and research in the field of non-lethal technology is booming and a wide range of improved or brand new less-lethal weapons is under development.



*An American soldier demonstrating the use of a taser weapon to Iraqi security forces*

## Sponge grenades

Sponge grenades are bullet-shaped grenades with a foam rubber nose and a high-density, plastic projectile body ring. They are used to target individuals (instead of in-



**Rubber bullets used by Nepalese troops to disperse crowds in Somalia**



**Demonstration of a dazzler from a US Navy ship**



**Israeli policemen armed with sponge grenades**

discriminately targeting groups) and cause no permanent damage, although cases of broken bones, head wounds and permanent damage to the eyes are recorded. If used at a distance less than ten metres, they may even prove fatal. In recent years, they have been used by the US, the Hong Kong police and Israel to disperse crowds, although it is best used when aimed at a particular individual. The development of less-lethal hand grenades is also encouraged: grenades with

blunt trauma and flashbang effects (stun grenades), 'sting' grenades with rubber shrapnel, and grenades designed to release chemical irritants such as tear gas. Less-lethal hand grenades are known to have been used in Gaza, Kenya and Egypt. The United States Marine Corps has developed an active denial system in which a high energy micro wave is used to rapidly and continuously heat all living matter in a certain target area. During the duration of the beam, intolerable pain is

inflicted on the target through the heating of the skin, but no lasting damage occurs.

Tests with Very Low Frequency Sound have proven to be successful in causing nausea, disorientation, loss of bowel control and vomiting. The acoustic waves can also easily penetrate buildings and vehicles, but when applied too long, they can cause internal organ damage and consequently death.

Other directed energy weapons that offer possibilities for less-lethal usage are the Ultraviolet laser that could immobilise living targets and even cars at a distance without any direct contact. The pulsed energy projectile creates a small amount of exploding plasma and a pressure wave that stuns and immobilises the target while causing considerable pain because the nerve cells are affected. The same technology could also be used to counter UAVs and drones.

A dazzler is a directed-energy weapon that uses intense directed radiation to temporarily blind or disorient the target, optical sensors and human vision alike. Most of the contemporary systems use lasers to blind the target and are man-portable. They reportedly were used by the Hong Kong police against demonstrators.

In the field of the chemical agents, like gases and sprays, spectacular developments are taking place: scent-based weapons producing strong, sewage-like odours that force people to leave an area and that stick to their body and clothes, facilitating the later identification of the rioters. Experiments with psychochemical weapons that use drugs like LSD to disorient the target are taking place, but since the effects on the target are highly unpredictable, their employment outside the laboratory seems unlikely. Sleep gas – used by the Russian security forces during the 2002 Moscow theatre hostage crisis that had a dramatic showdown – offers great possibilities for use in police and military operations. Sticky foam, on the other hand, was tried with some degree of success, but its use on the battlefield remains a complicated matter.

## Conclusion

This overview has simply highlighted the possibilities of less-lethal technology, now and in the foreseeable future. No doubt, this type of weaponry will be used more and more, at home against domestic uprisings and abroad in military operations. However, besides the technical and tactical difficulties, there are also a number of moral and legal issues that need to be solved before less-lethal weapons will really break through, especially regarding their military use. ■



# Energy Magazine

## A Key Enabler for Current and Next Generation Surface Combatants

Luca Peruzzi

The US Navy's DDG(X) programme envisages procuring a class of next generation guided-missile destroyers (DDGs) to replace the service's ageing TICONDEROGA (CG-47) class AEGIS cruisers. The DDG(X) is supposed to be the US Navy's first next generation large combatant platform designed from the outset to be equipped with laser and next generation weapon systems.

Both the US and UK defence forces, including navies, have and are continuing to develop, test and demonstrate different energy storage systems to cope with the requirements for both new and in-service naval platforms.

The stored energy of the Energy Magazine (EM) is required to supplement typical ship service power so that large pulsed loads are not directly tied to the electrical power generator, which potentially damages the

shipboard power system. According to US Department of Defense (DoD) technical documentation, the EM consists of power electronics, energy storage media, and controls in order to enable directed energy weapons, electronic warfare, and sensors meet shipboard distribution system requirements (such as MIL-STD-1399); at the same time this should allow multifunctional use of the energy storage assets. The Energy Magazine is a common, modular, scalable

intermediate power system that standardises energy storage across multiple mission systems and ship classes, eliminating the wasteful need for mission systems to each develop, build, test and qualify/certify their own unique energy storage systems. The Energy Magazine also provides stable back-up power functionality and leads to a reduction of uninterruptable power supplies (UPS) aboard ship, the US DoD explains. Additionally, approximately 30-40 per cent of the

### Path to the Future

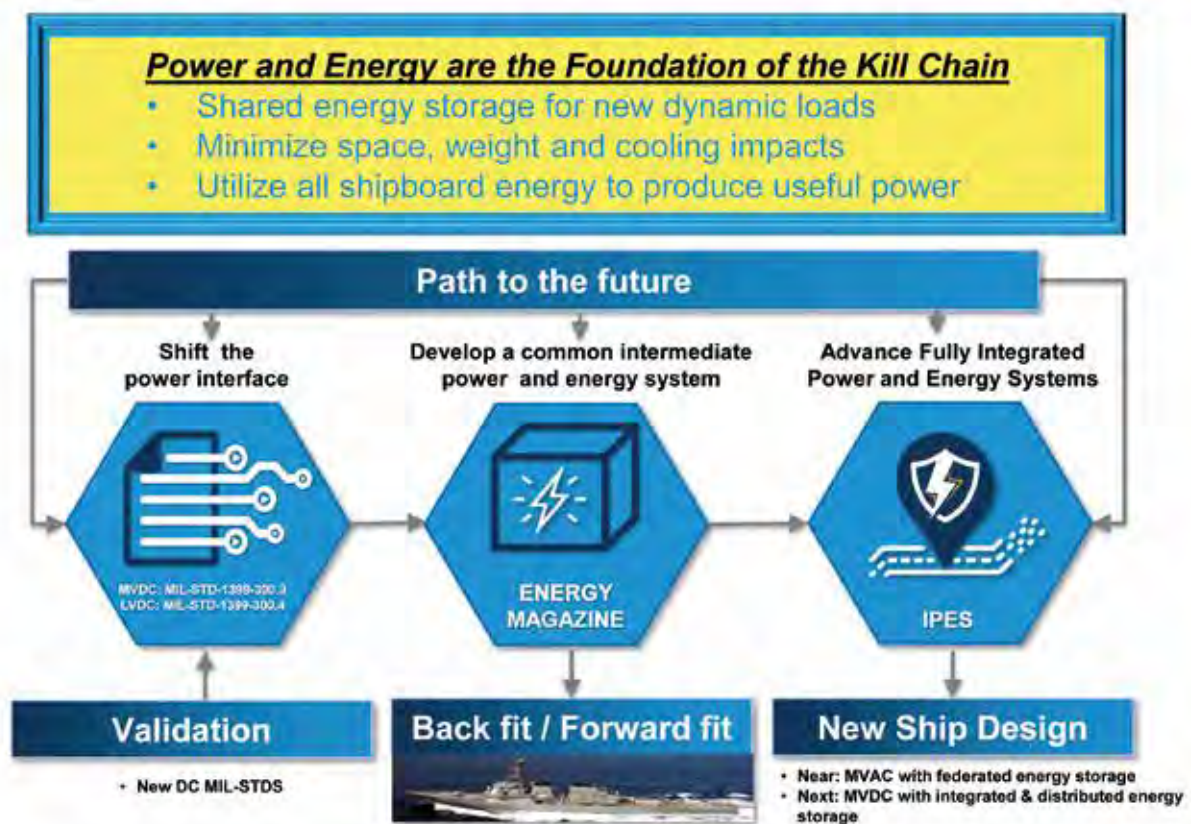
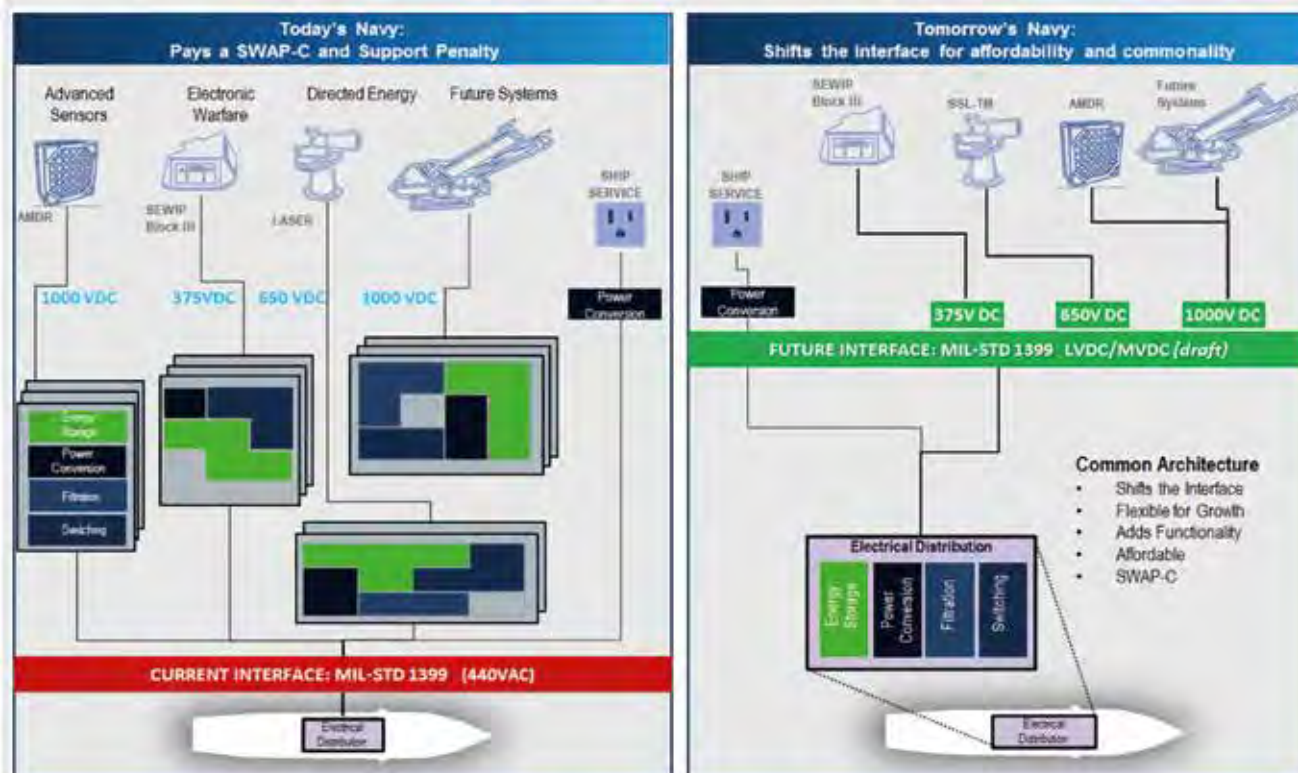


Photo: NAVSEA PMS 320

*The US Navy's DDG(X) programme will be the first next generation surface combatant to be equipped with laser and next generation weapon systems. Power and energy will be the foundation of the kill chain, according to the PMS 320 presentation at SNA 2020.*



## Tomorrow's Navy shifts the interface for affordability and commonality

*The US Navy's shifting of electrical interface towards mission systems as illustrated by the PMS 320 at SNA 2020*

cabinet components that support weapons and sensing systems are power conditioning; these can be functionally replaced by the Energy Magazine as a more universal power conditioning and energy storage unit that is ship power "reloadable" for multiple directed energy engagements. The Energy Magazine is designed for both new construction and retrofit applications where advanced combat systems loads are deployed.

### Directed Energy and Laser Applications

The US Navy has pursued an evolutionary energy storage development strategy for surface ships, where the service has already tested and demonstrated different energy storage devices. As part of the US Naval Sea Systems Command PEO SHIPS procurement organisation, the PMS 320 is responsible for developing naval power and energy systems that focus power system integration of Directed Energy (DE) and other high-powered mission systems, as well as platform integration and improving energy efficiency of those components and systems. The Energy Storage Module-Land (ESM-L) or the proof of concept for the land demo testing of the SSL-TM (Solid State Laser Technology Maturation) system where the energy storage media was based on lead acid battery technology in a 28' ISO container has evolved in the Energy

Storage Module-Ship (ESM-S) for the SSL-TM Laser Weapon System Demonstrator (LWSD) Mk 2 Mod 0 embarked on USS PORTLAND (LPD 27) SAN ANTONIO class amphibious transport dock. Developed by Northrop Grumman, this second iteration of SSL-TM, which is ultimately expected to become a 150-kW laser weapon, draws from lessons learned from Office of Naval Research (ONR) demonstrations and testing from 2011. The shooting down of a drone with the LWSD on May 2020 was a first-of-its-kind at-sea test by the US Navy of a high-energy laser weapon system. The Navy has developed and is testing a portfolio of laser weapons, including the High Energy Laser and Integrated Optical-Dazzler and Surveillance (HELIOS), which is planned to reach 60 kW and could be installed on board ships like the ARLEIGH BURKE class destroyers that have less power margin to add in new systems. The Navy has also pursued an Optical Dazzling Interdictor, Navy (ODIN) that would not be used to knock down incoming threats, but would rather be employed as a non-lethal option to warn away approaching enemy craft. The Electric Ships Office (PMS 320) has designed, built, and then tested at the Center for Advanced Power System at Florida State University (FSU CAPS) the Energy Storage Module (ESM) prototype and the Energy Magazine Bread Board, the latter to test active front end technology to enable peak

shaving. Developed by Leonardo DRS, the ESM prototype demonstrator, also known as EM-Laser, has been conceived to feature a modular architecture and adaptable software alongside a design compliant to multiple MIL-STDs and employs the latest technology lithium iron phosphate batteries by EaglePicher Technologies, which greatly contributes to reducing the size and footprint of the system to 1/10 the size of a lead acid battery-based system. The modular design of the system allows for flexible configurations to fit different applications and available footprint. Each of the building blocks represented by cabinets are sized to fit through common ship hatches for simple installation. With a 71 kWh (256 MJ) and 1000 VDC internal output in dual stacks, the EM Laser is capable of a 660 kW power for four minutes with a rechargeable time of less than 16 minutes and an overall weight of less than 4,200 kg. The system was successfully tested in 2018 at FSU CAPS. This centre uses power hardware-in-the-loop (PHIL) approach which includes the development of component computer models that simulate and emulate actual operating machinery components and ship-board power and energy systems until the hardware development is complete. PHIL testing costs less than full-scale hardware system testing, shortens development time, and affords the opportunity to identify and mitigate risks.



## Energy Magazine: Leveraging 9 Years of Investment

320

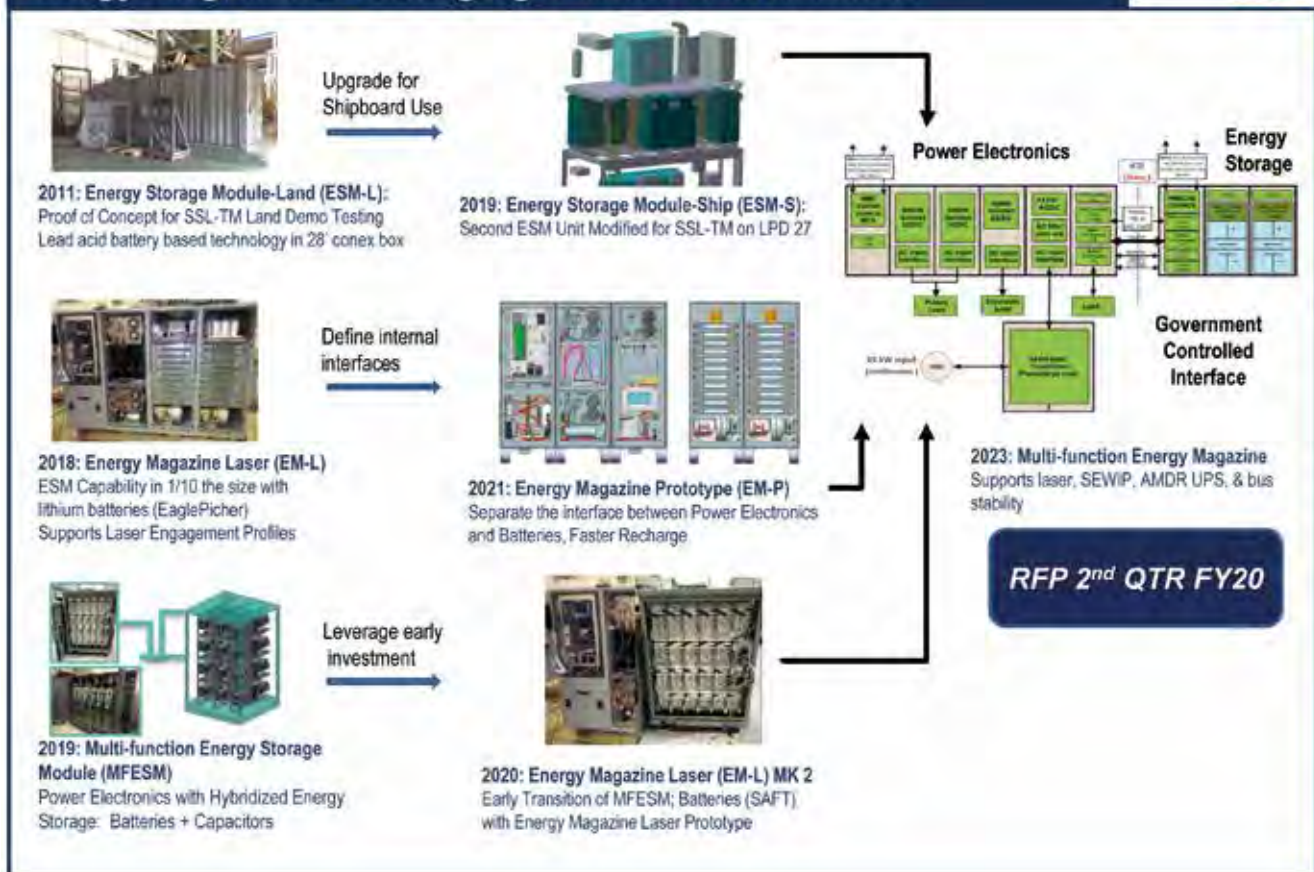


Photo: NAVSEA PMS 320

The future Energy Magazine leverages on more than nine years of investments. The US is also working with the UK to develop new capabilities.

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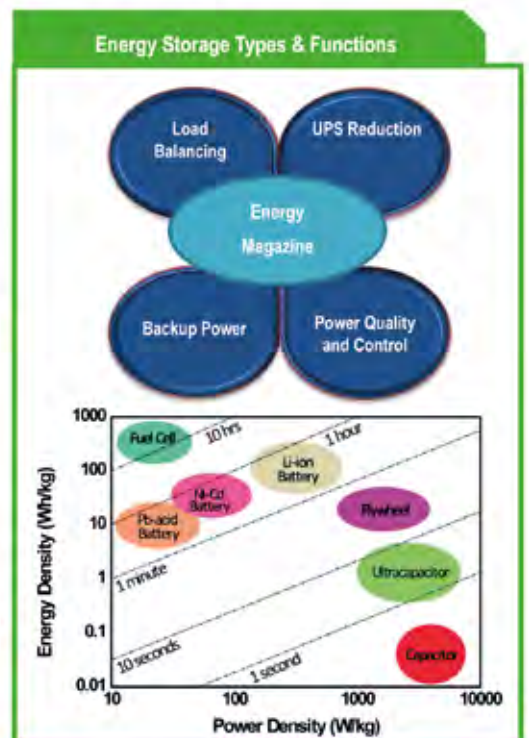
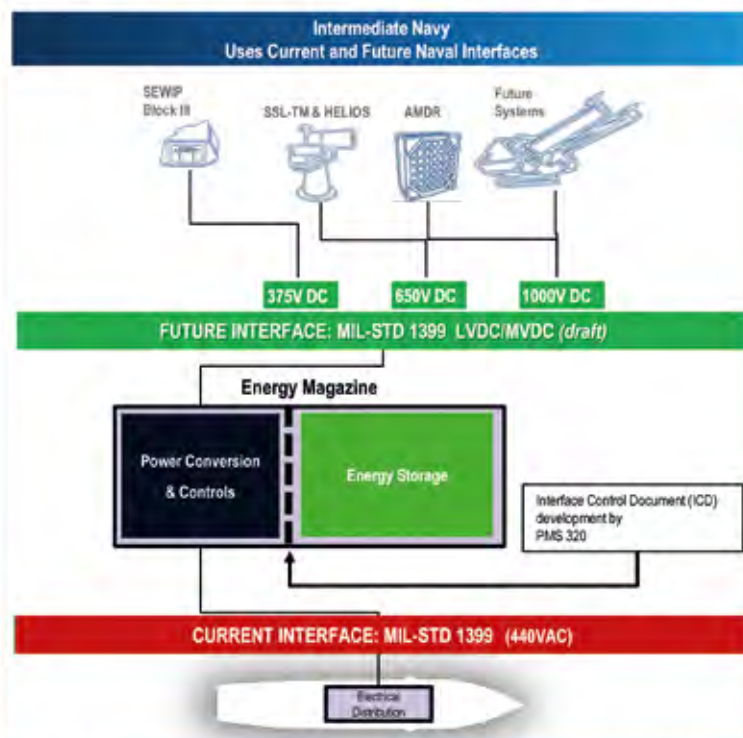
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## Energy Magazine Bridges the path to the Future with Back-fit Installations



## Energy storage couples today's ships with tomorrow's technology

*The Energy Magazine bridges the path to the future with back-fit installations, according to PMS 320 presentation at SNA 2020.*

Based on the successful EM Laser activities, Leonardo DRS was awarded the contract for the Energy Magazine Prototype (EM-P) programme. The EM-P is an evolution of the EM-Laser, with a separation of the interface between power electronics and batteries allowing energy storage media to be installed separate from power electronics, to offer further modularity and system flexibility, more power and duration and faster recharge. According to US Navy documentation, the service is continuing the development of the EM-P programme. Major efforts being conducted in FY 2021, according to US Navy documentation, are the completion of the design, ordering material, commencing the build and preparing for test readiness reviews prior to testing the EM-P. The programme evaluates system performances and, as applicable, incorporates lessons learned into EM procurement, while initiating preparation of test plans and procedures and test site modifications for independent government testing.

## Energy Magazine Programme

The US Navy is working on a further development called the Energy Magazine (EM) programme. The latter is seeing a competitive award of contracts to up to two contenders. The aim of the programme is the design and testing of a modular, scalable, multi-application EM, which serves as the energy resource thanks to energy storage media to enable the

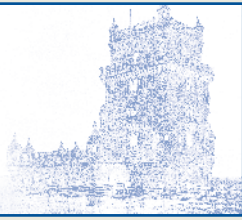
introduction of pulsed high power and energy weapons and sensor systems. EM simultaneously supports multiple pulsed loads such as laser, electronic warfare, radars, etc. When fully integrated, EM is expected to also reduce the number of Uninterruptable Power Supply (UPS) battery units on ships which decreases maintenance and costs. ESD understood the programme requires different versions of the Energy Magazine to operate on different power distribution systems on the ships (13.8kV, 4160V, 450V) for multiple different weapons applications (lasers, radar, etc.), as well as to support robust power distribution and, possibly, also to support propulsion. After a request for proposal (RfP) was released in Q2 2020 and a Best and Final Offer (BAFO) request was planned to be issued in Q3 2021, a contract is expected today to be awarded in the Q4 2021, after an initial schedule for Q4 2020.

## Forthcoming Energy Storage Systems

In FY 2021, Electric Ships Office (PMS 320) will take delivery of and complete transition of the ONR Future Naval Capabilities (FNC) product, the Multi-Function High Density Shipboard Energy Storage (MFESM) developed by General Electric. MFESM will be tested in a power hardware-in-the loop environment against representative naval warship electrical architectures and relevant directed energy weapons systems

loads at FSU CAPS to confirm performance requirements and validate digital models of system, according to US Navy documentation. As anticipated, while work is continuing, the PMS 320 has already tested and demonstrated different energy storage devices, including the United Kingdom (UK) Flywheel Energy Storage System, the Johns Hopkins University Adaptable Power Supply, and the Northrop Grumman Energy Storage System. The UK Defence Science & Technology Laboratory Dstl is working with British industry and the US Navy, under the continuing Advanced Electric Power and Propulsion Project Arrangement (AEP3A), to develop future energy storage options for British warships to power the next generation of naval laser weapons. Dstl and GKN developed the Flywheel Energy Storage System (FESS), using high-speed, lightweight flywheels to provide high-power electric pulses. For the UK-US testing of FESS, the teams used the PHIL approach which saw the integration of a real FESS system into a virtual ship power architecture that emulates a Royal Navy ship operating in real time. This was initially carried out in the US at FSU CAPS, then was taken to the Power Networks Demonstration Centre (PNDC) in Scotland to advance the United Kingdom's PHIL capabilities. This technology is expected to smooth the way for integration of next-generation weaponry with naval vessels, including the UK MoD's DRAGONFIRE, being developed by Dstl and industry in the UK.





# Viewpoint from Lisbon



Photo: Duarte Roriz

## Pragmatism From Portugal

**António Brás Monteiro**

The expression “looking through rose-tinted spectacles” dates back to the 17th/18th centuries, can be found in various languages. That it has the underlying proposition of naïveté and ignorant positivism is, we believe, precisely the

antithesis of the Portuguese Presidency of the Council of the European Union (PPCEU) and the path chosen by the European Union regarding Security and Defence for its member states.

No doubt remains that the PPCEU confirmed European resolve to move forward in the fields of security and defence. That determination was and is shared by both the previous German and the current Slovenian presidency.

With an ongoing pandemic and all the difficulties that it constitutes for all EU member states, most of the proposed objectives have been clearly met, and the European Council has been able to put emphasis on vital security and defence discussions and decisions in the scope of the EU Common Security and Defence Policy (EU CSDP), and stress the importance of a Permanent Structured Cooperation (PESCO) and the European Defence Industrial Development Programme as well as reaffirm the significance of partnerships with multilateral organisations such as the UN and NATO. With the mastery that is recognised to the current Portuguese Defence Minister, Mr João Gomes Cravinho, of dealing with high profile and sometimes rather controversial issues it seems now undisputable that the PPCEU has been able to achieve its main proposed objectives, namely the approval of the European Peace Support Mechanism, the approval of the European Defence Fund, the launch of the Coordinated Maritime Presences pilot project, the Strategic Dialogue Phase of the Strategic Compass and the EU support to Mozambique in the fight against terrorism.

Trying not to be exhaustive, one should highlight a few main central subjects of 2021 PPCEU.

The strategic importance of the NATO defence ministers meeting on 18 February stands out as a new element in a frozen relationship. The general relief with which the new Biden Administration was greeted is uncontroversial. Not disappointing, the new US Secretary of Defense Lloyd Austin reaffirmed the commitment towards “NATO 2030”, preparing the Transatlantic Alliance for the future.

Equally worth mentioning was the invitation of third countries by the EU to a PESCO project with the involvement of the USA, Canada, and Norway. Since the project's objectives include enabling the swift and continuous movement of troops and assets throughout the EU on land (roads and railroads), in the air and at sea, it is of extreme importance to the circa 70,000 US military personnel stationed in Europe with the mission to defend first-line countries in case of any aggression from Russia.

The same applies for the NATO battle group stationed in the region near Russia's border (led by Canada and joined by Norway).

The extraordinary meeting of the NATO defence and foreign ministers in April was also one of the unavoidable points that occurred during the period of the PPCEU. Being in line with Portuguese foreign policy in support of the efforts of the international community in the fight against terrorism, the withdrawal of the Portuguese military forces from Afghanistan reflects a compromise of the Portuguese contribution with the presence of elements in mission command structures and the annual contribution to the support fund of the Afghan National Army until 2024, and the end of Mission Resolute Support.

The PPCEU semester was also a period where, at internal level, Portugal had its hands full.

One must not forget that it was also during the PPCEU that the Portuguese Government, in a brilliant political move, appointed Vice-Admiral Henrique Gouveia e Melo as COVID-19 Vaccination Plan Task Force Co-ordinator, not only recognising the armed force's significance but also ensuring that the established goals were reached.

The polemic Armed Forces Reform was naturally one issue that caused a good amount of public discussion. Naturally, like with any important subject where change is the objective, the different points are exchanged, but a final decision must be taken. According to the Defence Minister, Mr João Gomes Cravinho, the objective is to have the Portuguese Armed Forces articulating and responding to future national and international challenges with a unified command, instead of what seems to be the case, in his view, of having three branches with relative autonomy pursuing parallel efforts towards the same objectives. Thus, the aim is having the Chief of the General Staff of the Armed Forces, representing the Portuguese Armed Forces, as the only point of contact for international organisations like NATO.

The authorisation for the acquisition of six new ocean patrol vessels for €352M by 2029, provided for in the Military Programming Law, is an opportunity not only for the Portuguese defence industry but also for the expansion of international commitments with bilateral scope or within the EU and the Portuguese Speaking Countries Community (CPLP).

In conclusion, this article cannot consider all the highlights of the PPCEU, however there is one that undoubtedly cannot be left out and represents reflection of the PPCEU pragmatism on tackling: the deteriorating situation in Cabo Delgado. Addressed several times under the PPCEU, the timings appeared to envisage the new US foreign policy as an important contribution. The process culminated with the bilateral meeting of the Portuguese and Mozambican ministers of defence and the signature of a 2021-2026 defence cooperation framework programme.

# Upgrading CHINOOK in Europe

**Esteban Villarejo**

**The UK, the Netherlands and Spain enhance their fleets of this iconic cargo helicopter while Boeing seeks new customers in Europe: Germany, Switzerland and Norway in the frame.**

The Boeing CH-47 CHINOOK helicopter serves the armed forces of 19 countries around the world. Among those nations there are five European NATO allies which are currently upgrading or purchasing new units of this twin-engine, tandem rotor and heavy-lift helicopter. The CHINOOK can fly at a maximum speed of 302 km/h and carry payloads greater than 9,525 kg.

## United Kingdom

Boeing has just been awarded a contract worth US\$2Bn for 14 H-47 Extended Range aircraft as well as engines, machine guns, radar and missile-jamming equipment for the choppers, according to officials and documents.

The United Kingdom will be the first international operator of a Block II CHINOOK. Deliveries are scheduled to start in 2026 and be completed in 2030.

This will give the Royal Air Force more versatility to execute the domestic and international heavy-lift missions that only the CHINOOK can facilitate. "These CHINOOKs are the future of heavy-lift, built on an existing foundation of advanced capability and life cycle affordability," said Andy Buita, Boeing vice president and H-47 programme manager. "This contract for Block II aircraft sets the stage for the next 60 years of CHINOOK excellence on the battlefield."

This contract includes: T-55-GA-714A engines, embedded GPS inertial navigation units; missile warning systems; radio-frequency counter-measures; multi-mode radars; electro-optical sensor systems; M-134D-T mini guns; and M240H machine guns. Boeing maintains the UK's existing fleet of 60 CHINOOK helicopters with 450 jobs across the country.

## The Netherlands

Boeing and The Netherlands Ministry of Defence signed an agreement in 2017 that upgraded the Royal Netherlands Air Force (RNLAf) CHINOOK helicopters to the latest F-model configuration, en-

Photo: Boeing



**A CHINOOK in the water**

Photo: RNLAf



**The Dutch CHINOOKs will be upgraded to the latest F-model configuration.**

suring commonality of systems for their entire fleet of 20 F-model CHINOOKs. Deliveries began in April 2020.

The 20 CH-47F CHINOOKs will be a fleet equipped with the same state-of-the-art technology as the US Army, including digital automatic flight controls, a fully-integrated Common Avionics Architecture System (CAAS) glass cockpit, advanced cargo handling capabilities and improved self-protection equipment. The common configuration leads to lower overall life cycle costs.

The Government of the Netherlands also requested support for the RNLAf CH-47

training programme, to include fuel; base operating support; facilities; publications and technical documentation; pilot training; personnel training and training equipment; weapon systems and software support and other related elements of logistical and programme support.

## Spain

Boeing is working to modernise the Spanish fleet of 17 CH-47D CHINOOKs to the newest CH-47F configuration, adding features such as the digital automatic flight control system, common avionics



architecture system and advanced cargo handling to align the country's fleet with those of other nations. This is a €819M contract and deliveries are expected to begin this year and be completed in 2025. The Government of Spain requested to buy the 17 CH-47F with 21 Common Missile Warning Systems (CMWS) AN/AAR-57A(V)8, and 42 Embedded Global Positioning Systems (GPS) and Inertial Navigation Systems (INS).

Also included are mission equipment, hardware and services required to implement customer-unique modifications, communication, Aircraft Survivability Equipment (ASE), and navigation equipment including AN/ARC-231 multi-mode radios, AN/ARC-201D SINCGARS radios, AN/ARC-220 High Frequency (HF) Radio, Identification, Friend or Foe (IFF), AN/AAR-57A(V)8, and the Radar Signal Detecting Set (RSDS), AN/APR-39A(V)1, special tools and test equipment, ground support equipment, airframe and engine spare parts, technical data, publications, MWO/ECPs, technical assistance, transportation of aircraft and training, and other related elements of logistics and programme support.

## Italy

Boeing and Leonardo Helicopters have delivered all 16 new build ICH-47F model CHINOOKs to the Italian Army Aviation unit after an agreement signed in 2009. "We remain in a collaborative agreement with Leonardo for the support of the Italian CHINOOK fleet." Boeing sources told ESD. That contract was worth US\$1.23Bn.

## Greece

The Hellenic Army retains a fleet of 25 CH-47D models in various configurations. There are no plans to upgrade this fleet yet.

## Possible New Customers in Europe

According to Boeing, multiple global defence forces are currently expressing high interest in the H-47. This includes Foreign Military Sale (FMS) and Direct Commercial Sale (DCS) opportunities with existing customers seeking to expand the size and capability of their current fleet, as well as new customers like Germany, Switzerland and Norway looking to transform their heavy-lift capabilities for the next several decades. "With more than six million flight hours and 950 aircraft in an actual combat operational environment – not in testing – the



Photo: Boeing

**Two CHINOOKs lifting howitzers**



Photo: RNLAf

**The CH-47 CHINOOK serves the armed forces of 19 countries around the world.**

Photo: RNLAf



**The primary mission of the CHINOOK is to transport troops, artillery, equipment, and fuel.**

Photo: RNLAf



**The CH-47F features an integrated digital cockpit management system. It is also equipped with advanced capabilities that enable efficient cargo handling.**

CHINOOK has an established global supply base for unrivaled affordability, around-the-clock part availability, immediate interoperability and streamlined aircraft maintenance and training procedures, as the US Army has several CHINOOKs stationed in Europe", Boeing told ESD.

### The Future: Block II Programme

What can we see in the future modernisation process? There are a number of ongoing efforts that continue to impact the evolution of the CHINOOK fleet. The US continues their modernisation efforts with

The latest advances in heavy-lift technology include an advanced digital cockpit which provides enhanced pilot situational awareness and autopilot capabilities. An additional feature is the digital automatic flight control system which enables pilots to hover in place and land in the most demanding of conditions. The new technology extends to a modernised airframe, which increases the aircraft's survivability and reduces maintenance. Finally, a cargo on/off loading system has been developed, enabling the aircraft to be reconfigured quickly.

the Block II programme, which sets the stage for the next 60 years of CHINOOK excellence on the battlefield.

The configuration introduces the new Advanced CHINOOK Rotor Blade to provide even more lift capability to the aircraft. It also features a robust 54,000-pound airframe that enables the aircraft to carry heavier loads, a new fuel system to better manage weight and mission length, a new drivetrain to give more power to the rotor system, and a new electrical system.

"We've also brought digital capabilities into the aircraft with how we designed the new airframe for a larger engine, and how we developed the new electrical system. Our digital capabilities, as evidenced on programmes like the T-7A Red Hawk and F-15EX Eagle II, have also played a critical role in the simulators, allowing us to make faster improvements to mission systems, reduce pilot workload and make the overall life cycle cost even more affordable", a source of the US company said.

As it pertains to US allies, Boeing has a history of providing CHINOOKs that are uniquely tailored to meet the customer's capability requirements at minimum cost.

"With the ability to leverage advanced, mature technologies from the US and international CHINOOKs, we are confident that the CHINOOK is the lowest risk, most affordable solution. We're constantly talking with new and existing operators about the best way to do that, and we are confident that we will be able to offer some or all of the capabilities involved in the Block II programme to our international customers".

Those decisions will be made on a case-by-case basis based on customer requirements.

"We pride ourselves in delivering CHINOOKs that are designed to meet each individual operator's most challenging missions", Boeing underlines.

For example, years ago the Royal Canadian Air Force needed a heavy-lift helicopter with additional capability to meet the country's demanding operational and environmental requirements. As a result, Boeing modified the Canadian CHINOOKs with unique radar systems and long-range fuel tanks, allowing the aircraft to fly twice as far as previous models. This has enabled the CHINOOK to operate across a wider range of environments and has proven particularly important for missions in Canada's vast northern regions. This approach is utilised by multiple international customers to meet their specific mission requirements and operational demands. ■



# The EU's BROADWAY Communication Initiative

**Thomas Withington**

**The EU's Project BROADWAY communications initiative promises to break down barriers between the continent's first responder emergency services.**

Not many of us have moved that far from our homes or, in some cases, our offices over the past year. The COVID-19 pandemic has greatly restricted our travel. However, reminiscence has not been subject to stricture. We can fondly recall how our smartphone would magically connect to a new country's cell phone network seconds after the cabin crew told us that we "could now switch off flight mode". In the blink of an eye, our trusty telephone was connected to a network we had maybe never heard of. Once more, we could instantly benefit from voice and data services akin to those we enjoy at home.

We can be forgiven for taking luxuries for granted. Perhaps we assume that this is the norm across all walks of life, but this is not the case for the European Union's (EU's) first responders. Police, paramedics and firefighters use radios to talk to each other and with their bosses. The trouble is that these radios often do not work beyond their home nation's borders. For example, a Swedish firefighter's radio may not work in Spain. A French Gendarme's radio may work badly, if at, all in Germany. At first blush, this may not seem like too much of a problem. Why would our Gendarme's radio need to work in Germany? Is it not unlikely that they would ever be in Germany performing their duties?

The reality is that in the European Union (EU), as with many other parts of the world, cross-border cooperation is increasingly common. After all, if a disaster occurs in Poland, its effects may not stay there. Take the example of a hypothetical freight train crash near one of Poland's borders. Let us suppose that the train is



Photo: Pxhere

***Traditional handheld radios remain de rigeur for first responders across Europe. However, such devices are not always interoperable across national borders.***

carrying several tank cars filled with diesel. The train crashes. Millions of litres of diesel, some of which ignites, and some of which contaminates a nearby river, spill out. The air is soon thick with toxic black smoke. The river is filling up with the slick black liquid, killing fish, birds and reptiles. It is threatening to flow into a lake causing yet more damage. Local firefighters are overwhelmed by the disaster. They call for assistance from across the border. Meanwhile, neighbouring authorities need information on the extent of the crash and the damage it has wrought. At present, the only way the respective national law enforcement, medical and firefighting personnel can communicate with their opposite numbers is to send information up the chain of command. Once at their respective command centres the information might need to be transcribed and redrafted as an email. The email must then be sent to the relevant command centre handling the disaster in the neighbouring country.

Alternatively, conventional telephone communications maybe used to share this information. All this adds complexity and bureaucracy at a moment where time and clarity is paramount. An added concern is that conventional telecommunications and internet traffic may not be as secure as it should be.

Consider another possibility: Our Gendarme is embedded with their counterparts in Spain's Guardia Civil (Civil Guard) national police force. They are part of an exchange programme helping to coordinate Spanish and French responses to drug trafficking across their border. The Gendarme might need to be outfitted with the same radios used by their Spanish counterparts. This will ensure that they can communicate with one another when out of the office. At the same time, our French officer may have to carry their own radio so they can stay in touch with their colleagues in France. At a stroke, the number of communications devices the Gendarme must carry are doubled. The same challenges regarding international bu-

## Author

**Thomas Withington** is an independent electronic warfare, radar and military communications specialist based in France.

reaucracy and communications are present as they are in our hypothetical Polish example. Surely, there has to be a better way.

## Project BROADWAY

Fortunately, there is. In 2015, the European Commission initiated Project BROADMAP, and subsequently Project BROADWAY in 2018. The commission is the EU body tasked with drafting European legislation. Project BROADWAY is carrying out a pre-commercial procurement with the goal to find technical solutions for later roll-out of a pan-EU communications infrastructure (BroadNet). This is intended to be used by the EU's first responder community. The initiative currently includes 11 procurers: the Czech Republic, Belgium, Estonia, Finland, France, Greece, Ireland, Italy, the Netherlands, Romania and Spain.

The introduction of 4G and 5G interoperable standards herald a step change for first responders. Dr. David Lund is the president of the Public Safety Communications Europe Forum. This is the coordinating body leading Project BROADWAY. He says that many of Europe's first responders are still using second-generation and Terrestrial Trunked Radio (TETRA) based communications (2G equivalent). TETRA has significant disadvantages. Using frequencies of 380 megahertz/MHz to 430MHz, TETRA is severely restricted concerning the data it can handle. Open sources note that this is typically in the region of 691.2 kilobits/kbps per second across a 150 kilohertz channel. It fairs even worse with data rates of 40kbps the norm. To put matters into perspective, 4G can handle data at rates of 100 megabits-per-second. This can even theoretically

eats bandwidth. It would severely tax current 2G and TETRA links. 4G and 5G offer a much better way of handling such data-heavy traffic. Thanks to the interoperability promised by Project BROADWAY, the information can be shared instantly not only with the Gendarme but with their Spanish colleagues. Another important consideration is that "the bad guys carry smartphones," says Dr. Lund. From a communications perspective police across Europe are 'out gunned' by hoodlums using these devices for nefarious business. In the 1960s, several British police forces started acquiring high performance JAGUAR motorcars. This was not for reasons of vanity. Instead, it reflected the adoption of fast cars by some of the villains of the day. Quite literally, the cops had to keep up.

## Services

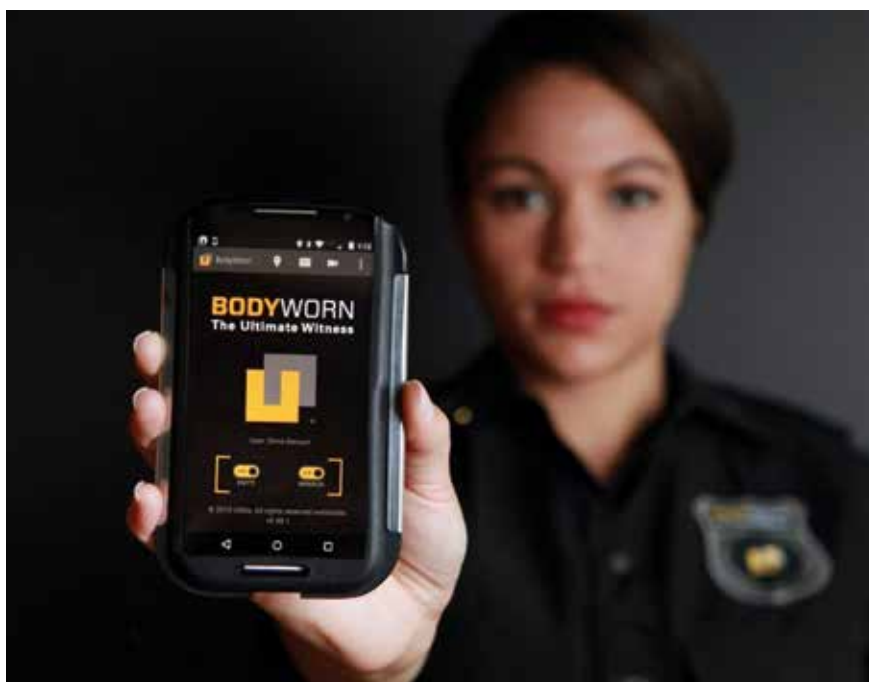
Dr. Lund emphasises that the crucial element of Project BROADWAY is the new service layer that it will provide first responders. This will guarantee that a host of standard services are available to personnel wherever they are in the EU. It is this service layer which will ensure their communications are, for all intents and purposes, 'network agnostic' wherever they go in a similar fashion to a civilian's smartphone: "We are not buying boxes of a certain kind," says Dr. Lund: "We are buying innovation".

His team are drafting Project BROADWAY's objectives and standards. It is up to industry to propose and devise the technologies which meet these. Once these have been proven and reached TRL-8 they will then be rolled out at the national level by the participating nations. The beauty of Project BROADWAY is that new countries can join the programme and roll out these objectives and standards into their future 4G and 5G first responder networks. From the outset, these will possess the interoperability Project BROADWAY is harnessing. This avoids these countries having to retrofit Project BROADWAY technologies into their networks later. Such an approach risks significant extra cost and disruption.

## Just a Phase

The programme is following a series of phases. Phase 1 has been completed. This constituted the design phase and defined the scope of the project, its aims and the requisite technologies. Project BROADWAY then moved into Phase-2.

Photo: Pxhere



**Smartphones are increasingly used for emergency services communications due to the volume of traffic that they can handle with ease.**

The project is evaluating several technologies that could provide interoperable mobile broadband communications to first responders in these countries and beyond. These technologies are to use fourth- and fifth-generation (4G/5G) wireless protocol architecture. EU information concerning the project says these technologies will be developed to Technology Readiness Level Eight (TRL-8). The EU's own definitions state that TRL-8 means that development of a technology or technologies is complete and qualified. The next step is TRL-9 which covers their introduction into live use (BROADNET).

stretch to one gigabit per second. 5G, which is being rolled-out globally this decade, takes things further. Predictions say that this could achieve rates of up to ten gigabits-per-second.

Why is this important? For first responders information saves lives. The more information they have concerning a particular situation, the more efficiently they can handle it. Returning to our Gendarme, their superiors back in France may need to send them videos, written data and recorded conversation regarding an expected movement of narcotics across the border from Spain. Such information

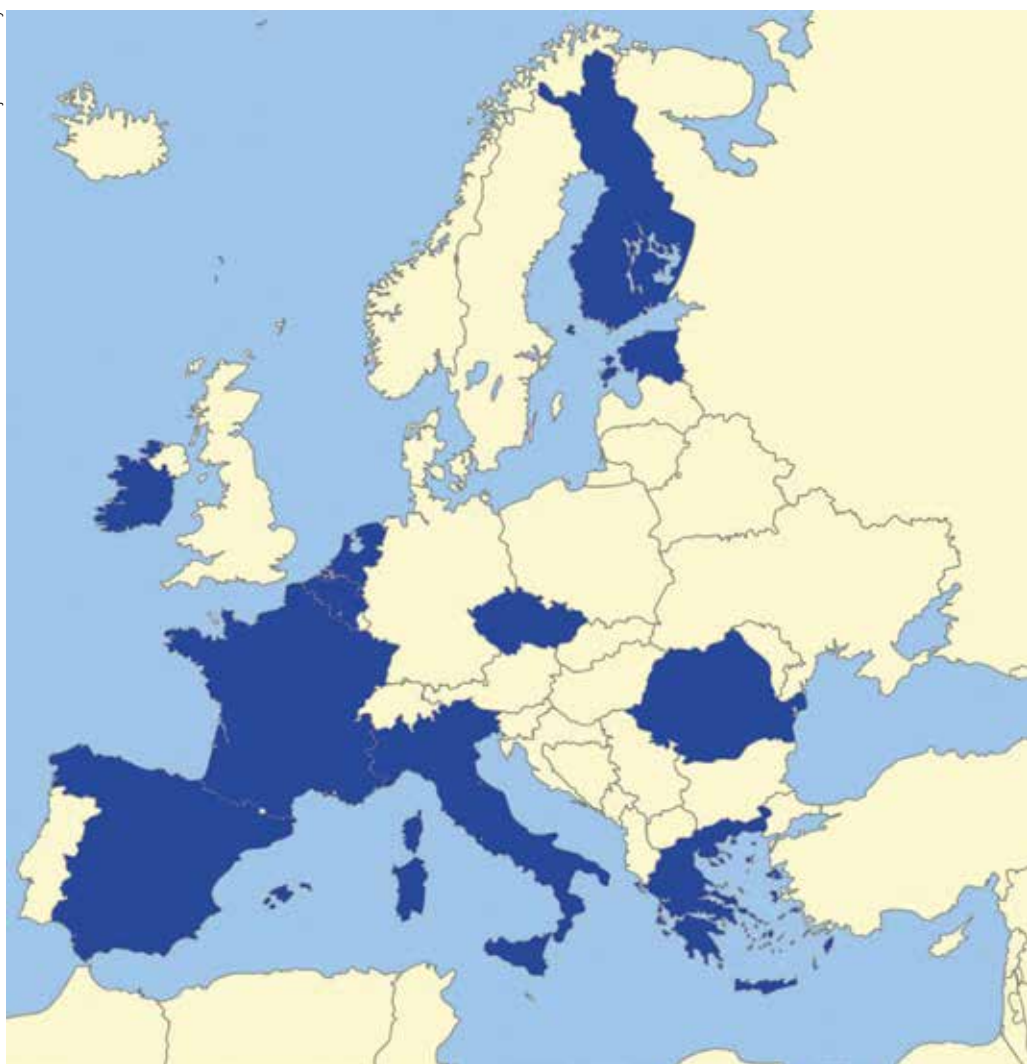


This is currently ongoing. Dr. Lund says that this concentrates on prototyping the technologies. Three consortia A, B and C are working on this phase. Airbus Defence and Space leads Consortium-A. This includes BICS and Proximus of Belgium and France's StreamWide Technology. Proximus is also involved as a subcontractor along with Poland's PentaTech and Umlaut of Germany. Consortium-B is led by Frequentis. The company has partnered with Nemergent Solutions, and the University and Municipality of Malaga, all of which are based in Spain. This is alongside Halys, Etelm and Crosscall of France. Subcontractors include Austria's Arico Technologies, the Franco-Swiss Eutelsat, Germany's Virtual Fort Knox and finally PrioCom and T-Mobile of the Netherlands. Leonardo heads Consortium-C. It is joined by Vodafone Portugal along with Ubiwhere and Proef; also Portuguese firms. Three Italian companies; Radiolabs, the University of Bologna and Athonet form part of Consortium-C. Finally, Finland's Bittium and Telespazio France are included. Both the UK's University of Lancaster and Italy's Iscom participate as subcontractors.

Dr. Lund says that Phase-2 is coming to a close: "We will evaluate the prototype phase towards the end of May." This will involve the number of participating teams being down selected to two. Once this selection has been made "we will invite the successful teams to compete for the pilot stage." The pilot stage represents the final step for the initiative. This will see the innovations pioneered for Project BROADWAY being brought to TRL-8. Once this is done, Dr. Lund expects a limited deployment of the technology to occur.

From a hardware perspective, Dr. Lund foresees that the individual first responder will end up with some sort of smartphone device; most probably ruggedised and outfitted with a headset. In the emergency services domain, the walkie-talkie radios of yore are giving way to smartphones. This is simply because a smartphone can do so much more. First responders are not just using so-called 'Push To Talk' (PTT) services anymore, says Dr. Lund. They need data and video services too. Such attributes can be easily provided with smartphone technology. Nonetheless, Dr. Lund expects traditional PTT radios to continue being used alongside Project BROADWAY's new technologies for some years to come: "Both walkie-talkies and the new smartphones will probably continue for a while, but the

Photo: Project Broadway



**A map of the Project BROADWAY member nations. Additional countries are expected to join the initiative in the future, further deepening interoperability.**

former will eventually be replaced," he predicts: "First responders know and trust PTT technology". Winning their trust in the new Project BROADWAY technology is imperative for ensuring a smooth transition. Getting the technology into the hands of emergency services personnel is an important step. Those using it will almost certainly help to devise new ways of employing the technology not necessarily envisaged by the developers. This could feed future innovations which could be rolled out across the Project BROADWAY infrastructure as it goes through its life. Another benefit of Project BROADWAY is that it will not require new communications networks to be built in the countries where first responders will use the technology. Such an approach would be highly impractical as it would require the network infrastructure to be built from scratch. Some countries will have some dedicated capability but

many will share commercial mobile radio access. Dr. Lund says that the Project BROADWAY service layer will be hosted by pre-existing 4G and forthcoming 5G national cellular and radio access networks. Participating nations will implement their system nationally and the Project BROADWAY seeks to leverage mobile standards to allow for interconnection between countries.

The advent of Project BROADWAY will herald a quiet revolution in how the continent's first responders communicate with one another. The work of emergency services does not always stop at national borders. Having capable communications working seamlessly with third party emergency services networks will be an important step towards facilitating this: "The challenge is operational mobility for first responders," Dr. Lund emphasises: "This is about ensuring that they can operate wherever they are as they would when they are at home." ■

# Human Factors Engineering 2.0

## Development of 3D human models with combat clothing and protective equipment

**Frank Schwarz-Müller, Ralf Bues und Christoph Poredda**

Personnel in military vehicles wear a broad array of combat clothing and protective equipment. As a result, they require more space. A German Army research programme aims at developing 3D human models with protective clothing to which mission-specific equipment could be added in order to give ergonomic engineers an adequate tool for the ergonomic design and evaluation of workspaces.

The driver's station must be designed for use by soldiers of the 5th percentile female up to the 95th percentile male." Even today, statements of work for military vehicles are worded like this in order to achieve an ergonomic design of the workplace for the largest possible user population. This approach is based on the assumption that if a workplace is designed for a 5th percentile female as the smallest person to be taken into account and a 95th percentile male as the tallest, an ergonomic workplace design for the 90% of users between both extremes is guaranteed. A percentile is a statistical variable that compares the position of a value such as body weight and size with other values of a collective. The 95th percentile means that 95 out of 100 people are below a specified value. This statement is correct if only one dimension, such as a person's height, is taken into consideration. However, a one-dimensional view is insufficient to ensure the ergonomic design of a workplace. Dimensions such as arm or leg length, trunk height and waist and chest circumference also play an important role. The second body dimension and any other dimensions that are ad-

Grafik: Sizing Up Australia, D. Veitch et al., 2009



**Model of a person based on body dimensions applicable to 95% of male humans**

ditionally taken into account reduce the circle of users by 10 % each. As a consequence, the user population for which the workplace is ergonomically designed is quickly reduced to 50% and below. Studies have also revealed that in real life, there are no people whose entire body dimensions conform to the same percentile. This becomes evident if you look at the extremes. The above image shows the model of a man whose dimensions are exclusively based on the 95th percentile.

The body shape of the model seems unnaturally distorted and would not occur in real life. This demonstrates that basing the ergonomic design of workplaces on percentiles has considerable deficits and explains why product developers are calling for alternatives.

One alternative is already firmly established in the automobile and aeronautics industries and consists of digital human models based on real three-dimensional

data (3D data) of the user population. The data the human models are based on are generated through mass screenings, using full-body scanners that can produce 3D models of the subjects wearing close-fitting underwear within a few seconds and without physical contact. A great number of such mass screenings have been carried out worldwide so that a large database for lightly dressed user populations has been compiled.

Unlike the subjects in the mass screenings, military personnel in military vehicles such as the BOXER MRV or the MARDER and PUMA AIFVs wear a broad array of combat clothing and protective equipment. As a result, they require more space, and the above-mentioned database is not representative of this group of persons. The consequences in cases where vehicles are not explicitly designed for this particular group of persons became evident in the course of a study conducted by the Bundeswehr Technical Center for Weapons and Ammunition in Meppen (WTD 91), the technical center responsible for ergonomics in the Bundeswehr.

In spite of the fact that it seems obvious that additional clothing and equipment lead to increased space requirements and restrictions of movement, there was no software solution that could generate 3D human models with protective clothing and equipment. In order to change this,

**Soldiers kitted out for military operations take up extra space.**

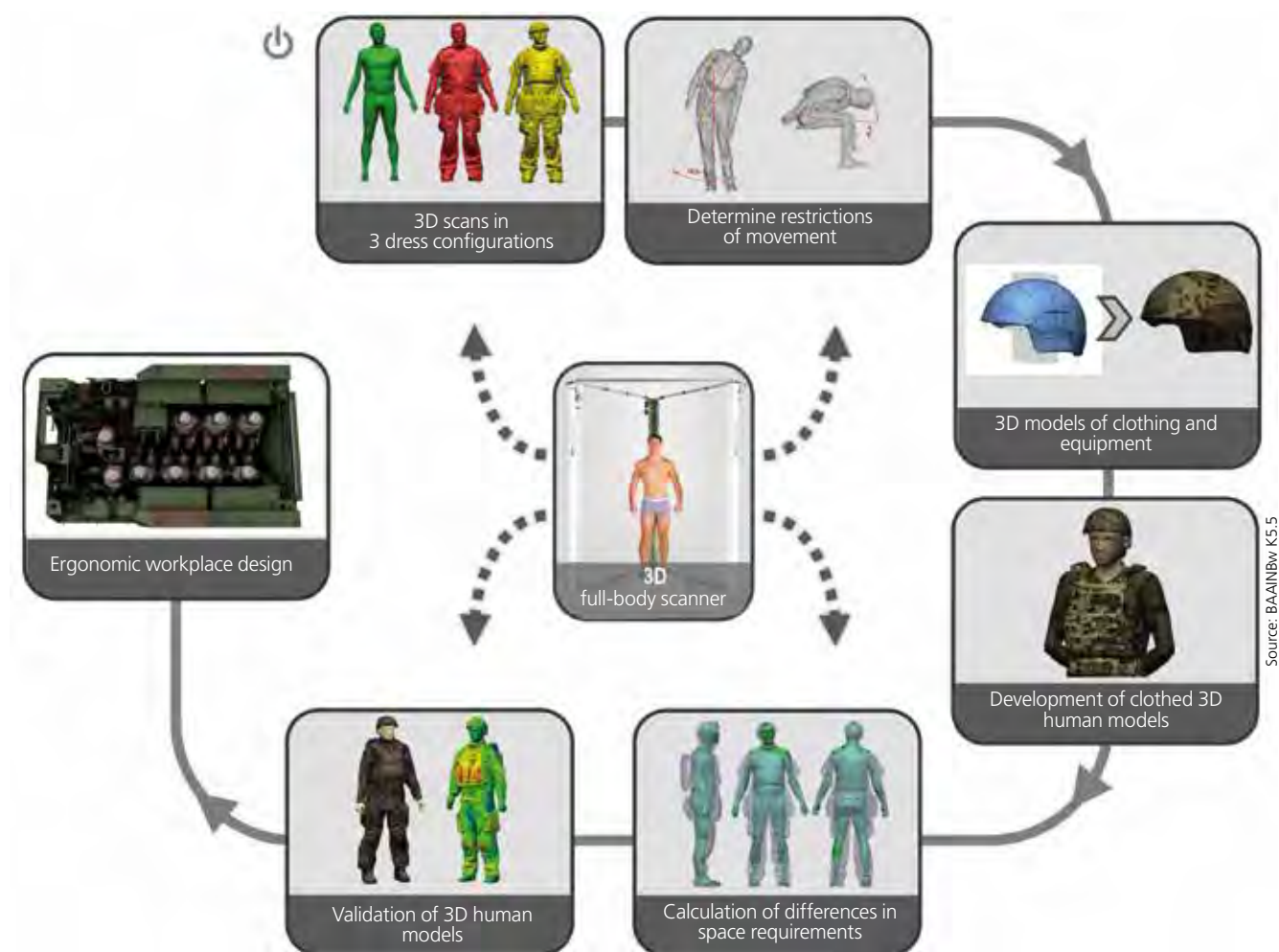
Quelle: WTD 91



### Authors

**Dr. Frank Schwarz-Müller** is Chief of Branch K5.5at the German procurement authority Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support (BAAINBw). **Ralf Bues and Christoph Poredda** are engineers at the Bundeswehr Technical Center for Land-Based Vehicle Systems, Engineer and General Field Equipment (WTD 41).





### ***Procedural steps for the development of 3D models with combat clothing and protective equipment***

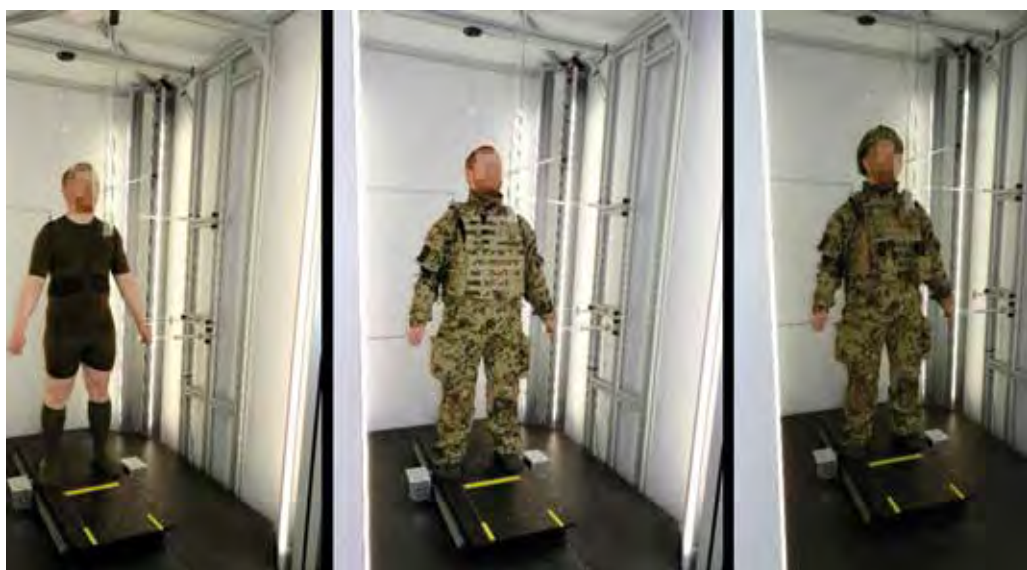
the Bundeswehr Technical Center for Land-Based Vehicle Systems, Engineer and General Field Equipment (WTD 41) initiated a joint research project with Human Solutions (Kaiserslautern), a leading developer of 3D human models. The aim of the project was to develop 3D human models with protective clothing to which mission-specific equipment could be added in order to give product developers and ergonomic engineers an adequate tool for the ergonomic design and evaluation of workspaces.

At first, functional requirements for the 3D human models with protective clothing and the individual steps of the development process were defined. The process steps are shown in the above figure.

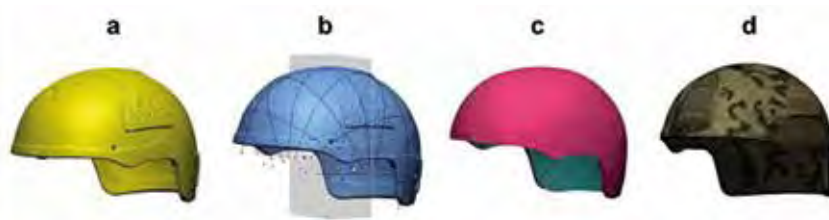
In a first step, WTD 41 captured 3D data of soldiers wearing combat clothing and protective equipment with the support of the Army Concepts and Capabilities Development Center. For this purpose, 37 soldiers wearing selected elements of the "Future Infantryman Enhanced Sys-

tem (IdZ ES)" were measured. This mass screening was performed using a state-of-the-art 3D body scanner. The scanner moves a horizontal laser line from head to toe and across the body in eight se-

conds and generates a three-dimensional image of the soldier consisting of up to four million image points. In this way, a database with 999 scans was created. The subjects were scanned in three dif-



***Body scanners are used to support dedicated design studies.***



**(a) Rough scan; (b) conversion into a CAD model; (c) data volume reduction; (d) color scan overlay**



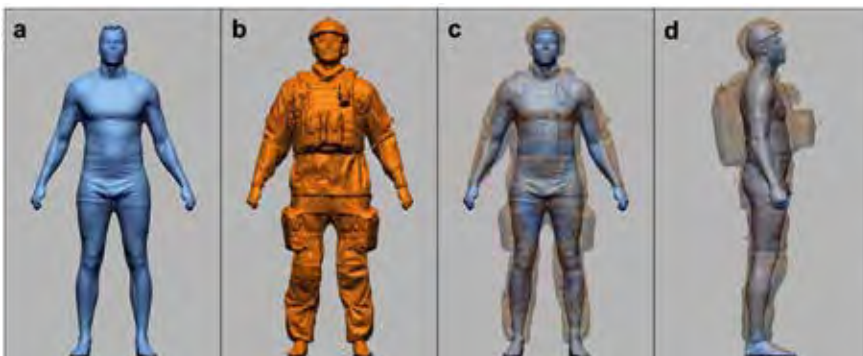
**Menu of the RAMSIS Defense clothing and equipment library**

ferent dress configurations in both sitting and standing positions:

- in close-fitting underwear,
- in combat clothing with protective vests as designed for drivers and other duty personnel in military vehicles,
- and with full protective equipment as it is worn, for example, by armored infantry soldiers in PUMA AIFV.

Afterwards, WTD 41 performed sepa-

rate scans of combat trousers, combat jackets, combat boots, helmets, “electronic backs” and protective vests. Human Solutions needed these scans for a clothing library that will later be used for equipping the 3D models as required. To this end, monochrome scans were taken using a high-resolution hand-held scanner in order to model the protective equipment as precisely as possible. A



**Overlaying of scans (c, d) to determine the volumetric differences between lightly clothed personnel (a) and personnel wearing protective clothing and protective equipment (b)**

realistic image is achieved by overlaying the model with color scans, which were generated using a second hand-held scanner. The required work steps are shown in the figure on the preceding page.

Protective clothing and protective equipment do not only require more space, though, but also restrict body movements. Since the 3D models are also intended to simulate complex movements such as getting on and off combat vehicles, the mobility restrictions resulting from wearing ballistic vests and combat boots had to be determined. To this end, the ergonomics specialists at WTD 41 analysed the mobility of the upper body and the arms with and without a protective vest, and the mobility of the lower legs and the feet with and without combat boots.

Human Solutions then had all the data they needed to develop the “RAMSIS Defense” software module, which allows equipping the 3D models with mission specific combat clothing from a clothing library.

The figure on the right shows the menu of the RAMSIS Defense clothing and equipment library, which consists of two separate windows. The right window is used to select clothing and equipment items, while the left window shows which of these items have been selected. In case more than one human model is required for an ergonomic assessment, they can be equipped independently with any combination of clothing and equipment items from the library.

The final, and very important, step in model development is to verify if and to which extent the models reflect reality. After Human Solutions submitted the first software version, WTD 41 took the next development step, namely validation. The task was to examine whether the clothing and equipment items increase the volume in the 3D models to the same extent and in the same areas as in the mass screening subjects. To this end, the scans of selected subjects in the dress configurations “lightly dressed” and “full protective equipment” were overlaid. The scans could be overlaid with precision because all subjects assumed the exact same posture in all dress configurations with the help of a positioning aid made of Plexiglas.

The results were then compared to the 3D models in RAMSIS Defense, which were created based on the body dimensions of the selected subjects and thus represented their likeness.

The comparison revealed that the volu-

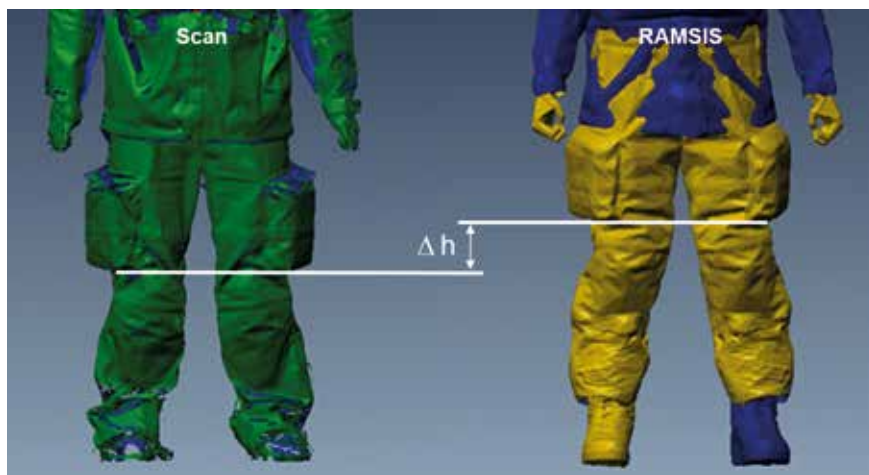


metric differences between the 3D models and the test persons were actually comparable, but that the areas in which they occurred varied in some cases. One example is the trouser pockets, which were located higher up on the RAMSIS Defense models than on the subjects.

The validation results were taken into account in the further development of RAMSIS Defense to achieve a market-ready product. Cooperation between the industry and the armaments organization generated a software solution that closes an essential gap in the development of products intended for personnel wearing combat clothing and protective equipment. Apart from the pure analysis of space requirements, RAMSIS Defense also supports the analysis of hand grasp areas, complex simulations of movements and the analysis of visual ranges. It is therefore not surprising that leading manufacturers of combat and support vehicles and Bundeswehr technical centers procured the software shortly after market launch.

Additional efforts are required, however, in order to establish this tool more deeply in the product development and assessment of military equipment. The next step now is to expand and regularly update the clothing and equipment library. The increased space requirements of protective clothing are not only an issue in military and civilian land vehicles (e.g. firefighting and police vehicles) but also in cockpits of fighter aircraft or aboard combat vessels. The effort involved in expanding the clothing library seems particularly worthwhile considering that the Bundeswehr Research Institute for Materials, Fuels and Lubricants (WIWeB) will start a mass screening involving 3D full-body scans of up to 2,500 soldiers across the three service branches and of civilian Bundeswehr personnel before the end of this year. As a result, an up-to-date and statically valid 3D database will be available that will allow defining a family of 3D models and their equipment that is representative for a specific user group in the Bundeswehr and can provide the basis for ergonomic workplace design. It is now up to the project managers at BAABW to request that the use of this valuable tool is included in the statements of work for vehicles and weapon systems.

In the meantime, the hope remains that the sentence "the driver's station must be designed for use by soldiers of the 5th percentile female up to the 95th percentile male" will soon be a thing of the past. ■



**Height difference in the position of trouser pockets between the real-life scan (left) and the RAMSIS human model (right)**



**RAMSIS Defense: (a) Analysis of hand grasp areas; (b) analysis of space requirements; (c) movement simulation**

Quelle: WTD 41

Quelle: Human Solutions

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# Polish Armaments Export Perspectives

**Grzegorz Sobczak**

On the global stage, Poland is not considered a leading armaments and military equipment exporter. According to latest data from 2019, the value of its armaments exports decreased from €489M in 2018, which represented the best result over the last decade, to €390M in 2019. In the pandemic year of 2020, this decrease will probably continue. However, some companies can expect some growth in the coming years because of new product development.

In terms of the value of Poland's exports, the highest amount of income is generated by the aviation manufacturing sector. Most of the Polish aviation industry belongs to international concerns or is represented in a sub-contractor role as with Leonardo or Airbus. Only PZL Mielec, part of Lockheed Martin, delivers final products, and this company has the largest share in aviation export production with its Sikorsky S70i BLACK HAWK helicopters and PZL's M28 transport aircraft.

countries purchased the PZL M28, the ex-US Air Force Special Operation Command aircraft, which were overhauled in Mielec. In this field, there is also potential for a new aircraft. One recent customer, a private German company using the M28 aircraft for training Bundeswehr paratroopers. The M28 is also offered by the Sierra Nevada Corp. in a combat support version known as the MC-145B Wily Coyote for US Special Operations Command. The MC-145B can even be employed as

## More Payload with the ROSOMAK

When considering Polish state-owned companies, all are members of the Polish Armament Group (PGZ). One is the Rosomak company which signed an agreement with Finnish Patria last year to extend its licence contract. The wheeled IFV ROSOMAK (AMV) will be manufactured in Poland after 2023, which will open up export opportunities, though the intention is primarily to fulfil Polish Army needs. Recently, 40 AMV vehicles manufactured in Poland have been exported to the United Arab Emirates. In 2019, Rosomak received a licence to manufacture AMV XP vehicles with a greater payload, and to offer these vehicles to the Polish Army. In reality, independent export deals will be difficult, but it remains an area of cooperation with Finnish Patria, which offers the AMV XP to Slovakia and Japan.

## HSW's New Programmes

The biggest potential for growth within the PGZ group – not only in export production – lies with the Huta Stalowa Wola (HSW) company which is focused on artillery systems and tracked vehicles. The latest, most well-known product is the 155 mm KRAB self-propelled howitzer. The KRAB combines the chassis of the South Korean K9 THUNDER with hydro-pneumatic suspension, together with the AS-90 turret system from BAE Systems with a 155 mm/52 calibre barrel, modified and manufactured by HSW. In fact, the KRAB is also available with an entire artillery system including all accompanying vehicles such as command and control and logistic support. Most valuable of all is KRAB's Battle Management System (BMS) TYTAN, developed by WB Electronics. HSW is currently delivering the KRABs to the Polish Army with final deliveries scheduled in 2025.

Photo: Grzegorz Sobczak



**PZL Mielec provides the highest value of Polish military exports whose flagship product is the Sikorsky S70i BLACK HAWK helicopter.**

In fact, the S70i BLACK HAWK remains PZL's most important product. The company has delivered this aircraft to Chile, Thailand, USA, and also to the Philippines which received delivery of 16 rotorcraft. PZL Mielec is currently focused on Romania, though demand for the S70i will most likely remain stable in the immediate future. Recently, a few European and African

a launch platform for JASSM. PZL Mielec will deliver green airplanes in this programme. The key difficulty with PZL M28 sales growth is the limited amount of after-sales support available, but the company is endeavouring to increase the number of maintenance organisations, especially in South America.





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**Wheeled IFV ROSOMAK equipped with ZSSW 30 remote controlled turret system**

The other HSW product is the 120 mm M120 RAK self-propelled mortar. The system's development started in 2004 as a wheeled self-propelled artillery system to support battalion level units. Initially, a turret with an automatic mortar was mounted on a ROSOMAK chassis, and this is the version ordered by the Polish Army. A tracked version is also being developed. Initially, the 2S1 GOZDIK self-propelled howitzer chassis was used, but recently, HSW announced a new programme with the lightweight tracked chassis development intended among others for the RAK, to be offered to the Polish Army. Similar to the KRAB is the M120 RAK mortar which is available in the company artillery fire module. The RAK is also equipped with BMS TYTAN. Deliveries to the Polish Army started in 2017 and will be continue at least until 2026.

The most interesting export perspectives involve two products whose serial manufacture has yet to be launched. One of them is ZSSW 30 remote controlled turret system developed together by HSW and WB Group. It is the most complex armament system developed in Poland in recent decades. The turret is armed with the ATK Mk44 BUSHMASTER II 30 mm canon, but

optionally other systems can also be used with greater calibre. In addition to the canon, the turret is equipped with a 7.62 mm machine gun, UKM-2000. But the most advanced weapon is the SPIKE LR launcher for two missiles.

The ZSSW 30 is equipped with a stabilised observation head on the top of the turret, controlled by the vehicle commander. The armament operator uses a separate observation system for fire targeting. The vehicle commander can take over armament control using his own observation system in the hunter-killer system. In case of an electrical power malfunction (the turret is powered electrically), the crew can control the system manually by mechanical controls and optical aiming device.

The total weight of the ZSSW 30 is less than the HITFIST 30P turret system used on Polish ROSOMAKS.

According to Bartłomiej Zajac, CEO of HSW, the company is waiting for contracts from the Polish Army for over 300 units of the ZSSW 30 turret system, which should be signed soon – maybe even during MSPO in Kielce in September this year. It will open the door for the promotion of this product to foreign customers.

The other product with huge export potential is the amphibious tracked IFV BORSUK (Badger). Because of its amphibious capability, the gross weight of BORSUK is limited to 25 tonnes. This requirement has forced designers to use some advanced solutions such as a lightweight vehicle floor with explosion absorbers to protect soldiers on board against of IEDs or mines, plus front and side armour providing PRG and ballistic protection.

The first choice of armament for the BORSUK is the ZSSW 30 turret system, but the M120 RAK mortar can also be installed on the vehicle. The BORSUK is powered by the MTU 8V199 TE20 engine, which delivers 720 kW of power, but based on customer demand, the vehicle can also be powered by another engine.

In the autumn of 2018, the BORSUK prototype passed its ballistic range tests and in 2020, its drive characteristics and firing tests were conducted. Details of the tests results remain confidential, but HSW's management claim that they are very satisfying.

HSW management also estimates the potential order number for the BORSUK is 700, with the goal to replace about 1,000 units of the Soviet-era BWP-1, as well as, in addition to this number, a further 700 special variants should be ordered.

Another HSW product which will be officially presented at MSPO is the 4x4 vehicle based on the TATRA vehicle chassis which could represent an ace up HSW's sleeve. The Polish Armed Forces keenly feel the lack of this type of vehicle, however, it might also prove to be of interest to foreign customers.

## BOLT for Export?

Huge export potential exists with the newest product offered by Mesko, also a PGZ member. In recent decades, the man-portable air-defence system (MANPADS) GROM (meaning Thunder) has been a very popular system and was particularly effective in the short Russo-Georgian War in 2008.

Based on the GROM system, Mesko has also developed the newest version of MANPADS, the PIORUN (meaning Bolt). One core element of the PIORUN and providing a high degree of effectiveness, is the new seeker head manufactured by Telesystem-Mesko, using nitrogen-cooled photo-resistors. Thanks to this head, sensitivity levels are increased, the seeker works longer, and the missile has a greater range. In military range tests, a front-viewed helicopter can be detected from 4 to 6 km distance, depending on the rotorcraft model. PIORUN missiles are able to hit low



**Amphibious tracked IFV BORSUK prototype presented to the Polish MoD in summer 2021**





Photo: PGZ

**Soldier armed with MSBS-5.56 GROT modular assault rifle from FB Łucznik-Radom**

flying targets (even at 10 m above ground), making them an effective weapon against NOE flying helicopters. The missile has three modes of seeking – for aircraft, UAVs, and missiles – with the correct algorithm of interception selected by the operator. It is a relatively simple procedure because of the three types of fuses used – proximity fuse, impact fuse, and eddy current fuse. The range tests have proven that PIORUN is highly resistant against enemy countermeasures, especially high temperature flares. Any heat source is analysed and the system is set according to the identified target. PIORUN also has a more powerful warhead and greater manoeuvrability compared to competing NATO MANPADS, as well as non-NATO systems. A few years ago, the export of the PIORUN was frozen due to concerns about the disclosure of sensitive defence technology, but with NATO countries, this problem should be easily eliminated.

### New MSBS from Radom

Polish arms manufacturer Łucznik-Radom, also a member of PGZ, has enjoyed some export success, notably with their assault rifle, the M762 BERYL (7.62 mm x 39 ammunition) purchased by Nigeria. For this contract, FB Łucznik-Radom will open an assembly line in Nigeria with an option to complete the manufacture of this weapon.

The BERYL is also a 'hot deal' in the private and sport users' market in the US. The first batch containing 0.223 s BERYL M1, 0.223 Remington ammunition short BERYL pistol, and the BERYL S 762 for 7.62 mm x 39 rounds delivered to the US in March this year was sold in just a few minutes.

But it is not only a post-AK-47 era weapon made in Radom, as there is a new perspective with the Modular Firearms System MSBS GROT, fully designed in Poland. This modular system, with its quick-change barrel, is based on a common upper receiver for a conventional or bull-pup design.

The MSBS-5.56 GROT has been designed for NATO 5.56 x 45 ammunition, but also comes in the MSBS-7.62N variant for 7.62mm x 51 ammunition and will also be offered for foreign customers.

### WB Group Products

It is also worth mentioning the private company, WB Group, which manufactures electronics, radio equipment, and UAVs. According to Piotr Wojciechowski, CEO of WB Group, 40 % of revenue generated by the company are export contracts. The company has departments in the US, Malaysia and Ukraine.

WB Group develops advanced and innovative systems including the TOPAZ integrated combat management system for artillery, using the FLYEYE mini UAV platform. The most popular product offered is the digital communication platform FONET, which is integrated with tactical ground vehicles. The system provides end-users with the ability to enhance connectivity and situational awareness, accessibility to lethal and non-lethal effectors, as well as to reduce decision-making and targeting cycles at the lowest tactical

level. FONET is produced under licence by L3HARRIS for the US Army. Last year, WB Group extended the licence for its US partner for the next three years.

Many solutions are based on the FLYEYE mini-UAV platform, which has seen success in Ukraine. In the conflict in eastern Ukraine, the system has been widely used without the loss of a single aircraft in combat. Other products with export potential are the loitering munitions WARMATE 1 and WARMATE 2. This system has been developed with a warhead weight similar to anti-tank missiles. Another popular product recently launched by WB Group is the new tactical communication system called SILENT NETWORK with its low electromagnetic signature, intended for battalion-level deployment of land forces, which can easily be scaled up for bigger formations. It is solution-based on lessons learned by the Ukrainian Army in the ongoing conflict in Donbas. The system has a few innovative solutions such as low power emission radios, small UAVs used as quasi-satellites to translate radio signals, and the capability to integrate any encryption system based on customer request. The system can be employed as an add-on to any military platform due to its small size (11 x 15 x 18 cm, and ca. 3 kg in weight). It draws a maximum of 12 W of power and uses an inexpensive omni-directional antenna. Furthermore, it connects to a vehicle network using an ethernet cable and supports a variety of network protocols. The soldier's radio weighs about 1 kg including battery, which is able to keep it running for up to 48 hours. Of course, the above-mentioned products are not all available for export. The list of Polish companies mentioned in the Polish Ministry of Foreign Affairs' report on Armament and Military Equipment Exports from Poland in 2019 contains about 70 such economic entities. ■



Photo: WB Group

**The mini-UAV FLYEYE is used in several systems developed by WB Group such as the TOPAZ integrated combat management system or SILENT NETWORK communication system.**

# SBCT Artillery Competition: A Status Report

**Sidney E. Dean**

As the United States armed forces refocus on waging peer- and near-peer warfare, the US Army has begun to fortify its combat units, including the Stryker Brigade Combat Teams or SBCTs. Among other improvements, the SBCTs will replace their current towed 155mm artillery with self-propelled howitzers to enhance manoeuvrability, survivability and lethality.

To this end the Army is seeking a truck-mounted weapon on a 6x6 or 8x8 wheeled tactical carrier. The vehicle must be all-weather and all-terrain capable in order to keep up with the 8x8 Stryker Infantry Fighting Vehicles (IFV). The weapon system should feature increased range and rate of fire over the current M777 towed howitzer, which has a maximum range of 40 km when firing EXCALIBUR shells and a sustained rate of fire of two rounds per minute. The howitzer must be capable of rapid, sudden and intensive fire to surprise, suppress and destroy enemy forces while Stryker IFVs and dismounted infantry manoeuvre and fight. A Multiple Rounds Simultaneous Impact capability is desired to maximize lethality. Recognizing an urgent operational requirement, the Army will consider only weapon systems with minimal technological risk. As the United States has to date preferred armoured and tracked self-propelled artillery, the majority of contenders for the SBCT role are foreign models.

## The Competition

In late 2020 the US Army selected five vendors offering suitable production-ready or in-service howitzers to participate in a "shoot-off" competition at the Yuma Proving Ground (Arizona). The contenders face a variety of challenging combat scenarios, allowing the Army to evaluate their potential for the SBCT role. US soldiers operate the howitzers during the competition; their feedback will flow into the final evaluation of each weapon system.

**AM General** is the only strictly US-based competitor. Introduced in 2018, the

Photo: US DoD



**A French Army CAESAR howitzer firing in Afghanistan in 2009.**

Photo: US Army



**AM General's truck-mounted BRUTUS 155mm howitzer**





Photo: Bofors

**The ARCHER 155mm howitzer system.**

firm's BRUTUS howitzer, mounted on an open bed 6x6 truck, was specifically developed as a replacement for towed 155mm weapons. The gun's unique hydraulic-pneumatic cocking system reduces recoil by circa 60 percent, minimizing stress on the vehicle chassis and permitting use of a smaller platform. At 11,800 kg, the 7.6 metre long vehicle is the lightest of the competitors, enhancing mobility at the expense of protection. The 5-7 person crew can maintain a sustained two round per minute rate of fire (maximum: five rounds per minute), achieving a maximum range of 30 km firing rocket-assisted projectiles.

**Bofors** is presenting its ARCHER howitzer currently serving with the Swedish and Norwegian armies. ARCHER can fire within 20 seconds of stopping, and can move on 20 seconds after firing the last round. The crew can remain inside the armoured cabin throughout the firing process. The howitzer can fire 21 rounds within three minutes, at ranges up to 50 km. Anti-armour munitions can achieve 35 km range. While the ARCHER has a three person crew, the level of automation permits operations by a single crew-member.

**Elbit** is offering the Autonomous Truck Mounted Ordnance System or ATMOS Iron Sabre. The weapon has a semi-automatic loader with manual backup. Maximum range is 65 km, with a potential rate of fire up to six rounds per minute. Set up and take down each require 30 seconds.

**Nexter** is proposing the CAESAR (Camion équipé d'un système d'artillerie – truck-mounted artillery system) howitzer which entered French service in 2008. The battle-tested weapon system comes on a 6x6 or 8x8 chassis. The latter carries 30 artillery rounds.

**Yugoimport** presented the NORA B-52 M21 howitzer, the latest variant of the

firm's NORA line. The 52 calibre 155mm gun resides in a turret in the aft portion of the vehicle. Equipped with a computerized firing system and a 36-round automatic loader, the weapon can fire in automatic, semi-automatic or manual mode. The weapon is ready to fire 90 seconds after coming to a stop. Rate of fire is 12 rounds in less than four minutes with a range – depending on munition – of up to 52 km.

## Testing, and Beyond

The shoot-off is currently underway. The comprehensive testing cycle lasts 90 days per competitor, with each competing platform firing hundreds of rounds. Competitors begin the evaluation in a staggered order due to space constraints at the testing facility. The shoot-off began in Spring 2021, with the ATMOS completing the evaluation in May. The Serbian NORA is currently undergoing testing. According to the Summer 2020 solicitation for the competition, "information from the Shoot-off Evaluation will feed an Army Senior Leader (ASL) Decision Point concerning the future of the US Army mobile howitzer effort." To date the Pentagon has not revealed when such a Decision Point will take place or when a potential procurement contract might be awarded. ■



Photo: Serbian MOD

**The NORA B-52 M15 variant is in service with the Serbian army.**

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# The Electro-Optical Systems Specialist

Photos: EVPÚ Defence



**Patrik Hlůšek is the Commercial Director of EVPÚ Defence.**

**ESD:** We have learned that the management and staff of EVPÚ Defence are celebrating a major anniversary this year. Can you elaborate on the company's history and current figures? How many of your employees work in Research & Development?

**Hlůšek:** We are celebrating 20 years in business. EVPÚ Defence was founded in 2001 with the aim of providing innovative electro-optical security solutions for border zones and other areas of interest. Some of our first surveillance and monitoring vehicles were produced shortly after the company's foundation and went to protect the Latvian borders. Nowadays our portfolio also includes electro-optical devices for military vehicles. Around 20% of our highly qualified staff work directly in the R&D department. However, many other specialists are involved with the development of our customised products indirectly through prototype production and testing.

**ESD:** EVPÚ Defence has been known as a company specialising in Remote Controlled Weapon Stations (RCWS). What does your product portfolio look like and what features distinguish your products from those of your competitors?

**Hlůšek:** The RCWS segment of our portfolio is where our customers can expect the biggest changes this year. Currently we offer two types of RCWS. The smaller RCWS can be integrated with machine guns up to 7.62 mm while the larger RCWS can carry heavy machine guns up

**Prior to the IDET exhibition in Brno, Czech Republic, ESD had the opportunity to speak to Patrik Hlůšek, the Commercial Director of EVPÚ Defence, a Czech IDET exhibitor celebrating its 20<sup>th</sup> anniversary 2021.**



to 12.7 mm and a range of other weapon systems. We plan to show our innovations in this field at the IDET 2021 exhibition in Brno, Czech Republic.

**ESD:** How many company sites/subsidiaries/field offices do you operate and where? Can you refer to established industrial partnerships?

**Hlůšek:** Our design, development, production and servicing activities are concentrated in Uherské Hradiště. Of course, our customers come from all over the world. In order to serve them better, we have a network of local partners in many countries. These partners are companies that employ qualified technicians who are experienced in the integration of our products into the local end users' devices and applications.

**ESD:** What does your customer base look like? How many EVPÚ Defence products are in service with the forces of how many countries and for what applications?

**Hlůšek:** We supply our products to more than 40 countries in the world. Typical end users of our products are the Police, Army, Coast Guard, Border Guard and organisations such as Frontex. Although the majority of our projects are land-based, in recent years there has been a growing demand for our gyrostabilised solutions for naval applications.

**ESD:** Why should visitors and delegations at this year's IDET in Brno plan to visit the EVPÚ Defence exhibit?

**Hlůšek:** This year's EVPÚ Defence exhibit will focus on our defence segment. As previously mentioned, we plan to in-



**EVPÚ Defence headquarters and production facilities in Uherské Hradiště, Czech Republic**

roduce our innovations in the field of remote controlled weapon stations, commander and gunner sights, and additional protective systems for light armoured vehicles. Visitors and delegations are also welcome to discuss any special security and defence needs they might have as we are able to offer complete customised solutions.

**The interview was conducted by Jürgen Hensel.**

Photo: EVPÚ Defence



**CRANE-XSR gunner sight – a ruggedised electro-optical container for short and middle range applications**

# Technologies in Support of Night Combat

**Jan-Phillipp Weisswange**

"Own the Night" is the basic principle of night combat capability. It has meanwhile evolved in view of the further development and proliferation of night vision technology. Now the call is "Keep the night!"

Night combat capability enables troops to operate at night and in limited visibility conditions on the battlefield and, most importantly, to detect, recognise, identify and act more quickly than the opponent. For infantry and dismounted forces in particular, the requirement for night combat capability presents challenges in terms of equipment, armament and, increasingly, training.

Photo: US Army / Patrik Orcutt



**German SOF snipers practise shooting at night. The thermal imaging attachment is mounted in line with the day-vision sniper scope.**

## Principles

Some physics in advance: the human eye can process only a small portion of the light spectrum. Its natural detection capability is optimised for daylight. Only a small portion of the electromagnetic spectrum, namely the light or colour spectrum, is visible to humans. This begins above the ultraviolet (UV) at a wavelength of 0.38  $\mu\text{m}$  and ends at the near infrared (NIR) at a wavelength of 0.7  $\mu\text{m}$ . According to a more recent categorisation, the NIR is followed in the electromagnetic spectrum by the Short Wavelength Infrared (SWIR; up to 1.7  $\mu\text{m}$ ) and the extended Short Wavelength Infrared (eSWIR; 1.4  $\mu\text{m}$  to 3.0  $\mu\text{m}$ ). These are followed by the higher wavelength range of Mid Wavelength Infrared (MWIR; 3.0 - 5  $\mu\text{m}$  wavelength) and Long Wavelength Infrared (LWIR, 8 - 14  $\mu\text{m}$  wavelength).

## Technologies

Different technological approaches exist in order to enable the human eye to see at night. With the second and third generation image intensifier tubes available today, the obsolete active approach

is out-dated. In this case, the shooter had to use a light source invisible to the naked eye in order to be able to see at all with his night vision device. Nevertheless, this principle of illuminating the target area with IR light has evolved further: for example, modern, very compact laser and laser-light modules on small arms make it possible to assign or mark targets or to illuminate the target at close range. Light discipline must therefore still be maintained, as one is detectable by an enemy equipped with night vision technology. Passive night vision devices operate either as residual light intensifiers (image intensifier or I<sup>1</sup> or I<sup>2</sup> for short) or as thermal imaging/infrared imaging devices. Image intensifiers use the available natural light. The second and third generation devices in use today make do with low levels of residual light or infrared light. Thermal imaging devices work according to the principle of thermography. They respond to the self-radiation of sources of different temperatures and convert temperature differences into an image. In turn, they can be divided into the lighter, smaller and quicker to use uncooled de-

vices and cooled devices. The latter provide significantly better optical quality. Furthermore, the "SWaP values" - size, weight and power - which are always aimed at being as low as possible, are now falling for these devices. Thermal imaging devices are particularly suitable for imaging in the MWIR and LWIR ranges. MWIR devices are considered more suitable for hot and hot-moist applications, and LWIR devices for colder and dry applications. In the meantime, the trend of sensor fusion has become established: image intensifier and the thermal image are displayed to the user in combination. In addition, the increasing networking with other devices allows the user to have further situational-relevant data fed into his display.

## Pathways to Night Combat Capability

Infantrymen achieve basic night combat capability by combining night vision goggles with their small arms' day-vision optics and laser or laser light modules. Most

## Author

**Dr. Jan-P. Weisswange** is a Lieutenant Colonel (Reserve) of the German Army Reconnaissance and Intelligence Corps. He works full-time as a PR consultant in the defence industry. This article reflects his personal opinion.





Photo: AIM

**Demonstrator of the HuntIRsw from AIM. At 145 mm long, 110 mm wide and 95 mm high, the HuntIRsw weighs about 1 kg and provides at least four hours of operation.**

day-vision optics have night settings in which the reticle is illuminated by light emission in the non-visible range. Tactical operation and shooting with night vision goggles, day vision optics and laser light modules must be intensively trained and practiced, since the interaction of the devices differs considerably from day vision operation. In practice, it has been shown that targeted shots are possible at around 100 m.

Day-vision optics - especially telescopic sights - can still be made capable of night combat by using attachments. This approach offers the great advantage that the weapon does not have to be readjusted or zeroed. In addition, longer ranges are possible. Stand-alone optics, which can be used at night as well as day, offer another option.

Considerable advances have been made in recent years in all areas. In this context, the leaps in technology are proving to be enormous, particularly in terms of SwaP values, performance and networking. As sensors are now reaching their physical limits in terms of performance, companies such as Vected see the next leaps in performance in digital image processing - for example, through the use of artificial intelligence.

## Current Projects and Providers

Night vision goggles (NVGs) are part of the equipment of many modern armed forces - even if not yet cross-sectionally everywhere. However, their use is increasing. Numerous manufacturers have been able to place large orders in this area in recent years. Examples for western armed forces are: Elbit Systems (XACT NV32 MICRO, XACT NV33), Thales (LUCIE, LUCIE II/O-NYX, BONIE, NELLIE), Theon (NYX), L3Harris (AN/PVS-31, Fusion Goggle Enhanced/FGE and Ground Panoramic Night Vision Goggle/GPNVG-18). Also of note is the Enhanced Night Vision Goggle-Binocular (ENVG-B), supplied by L3Harris or Elbit Systems USA, which acquired Harris' night vision business in April 2019. Some of the models already feature sensor fusion as



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**The combination of night vision goggles (here an Elbit System XACT nv33 as Bundeswehr BiV Birle light), day vision optics and laser light module makes infantry fighting soldiers in principle capable of night combat.**



**The GPNVG-18 provides a larger field of view than binocular NVGs**



**The Elbit XACT th64**

standard, such as Thales' LUCIE-II-IR. But there are also thermal imaging add-ons, such as Safran Sagem's ECOTI, the Thermtek CLIP-IR and Berlin-based Andres Industries' CLIP-IR.

L3 has now combined two of its top NVG models. The Fusion Goggle Enhanced, known as the AN/PSQ 36, a binocular sensor fusion goggle, and the GPNVG-18, popular as the "Quadeye," with its large 97° field of view. The new device thus combines the advantages of sensor fusion with the large field of view.

In the field of Thermal Weapon Sights (TWS), Theon has achieved a number of sales successes in recent years with its DAMON family. The German Armed Forces alone have procured around 1,500 devices for medium and longer ranges. Other popular devices include the L3 CRATOS (Clip-on Ruggedized Advanced Thermal Optical Sight), an uncooled thermal imager weighing about 450 g that can be used as an attachment, handheld or separate targeting device. Safran Sagem (SWORD), Selex, Excelitas/Qioptiq (DRAGON C, DRAGON-LR, MERLIN LR), Meprolight (HUNTER X4), Optix or Andres Industries (TIGIR) are also active in this field, to name a few.

The German Armed Forces recently placed an order with Hensoldt for 368 units of the IRV 900 A2 thermal imaging attachment. This can be used as a standalone unit with digital zoom. L3 has also continuously developed its thermal imaging attachments. The CNVD-T3 is still widely used. In the meantime, follow-on devices such as the LIGHT WEAPON THERMAL SIGHT-LR (for Long Range) have appeared. The military designation is AN/PAS-13G(V)1. Meprolight has an entire line of multi-spectral devices in its NYX 200 family. These combine an uncooled thermal imaging channel with a day-vision or low-light camera.

In 2019, the Israeli Defence Forces began procuring XACT devices from Elbit Systems. These are also uncooled thermal imaging devices. The XACT TH65 is a clip-on device, while the XACT TH64 is a stand-alone device. Vehicles can be detected with these devices at a distance of 1,100 or 1,250 m, and persons at 600 or 750 m. Elbit had previously supplied the Australian Armed Forces. Elbit's US subsidiary, in turn, was selected by the US Marine Corps in September 2020 to develop prototypes for the Integrated Clip-on Advanced Targeting Sight (ICATS) programme under which the USMC is seeking a multi-spectral targeting optic. Leonardo DRS, in turn, was awarded a multimillion-dollar contract by the US



Army in October 2019 to deliver Individual Weapon Sights (IWS). The un-cooled clip-on thermal sights are being procured under the project name Future Weapon Sight - Individual (FWS-I). They communicate wirelessly with devices such as the ENVG-B and integrate with the Integrated Visual Augmentation System (IVAS).

Picture: US Army

## Networking and Sensor Fusion: the US Army's ENVG-B and FWSI Projects

Networking night vision devices with command and control systems and the sensors of other platforms, as well as with augmented reality applications, are no longer a vision of the future. The FWS-I and ENVG-B can already be networked to enable Rapid Target Acquisition (RTA). The reticle of the target optics is combined with the field of view of the night vision goggles: In his II goggles, the shooter can have the thermal image of the weapon sight displayed. In this way, it is possible to use the weapon optics to look out of cover or around corners without exposing oneself to enemy fire.

The approach itself is not fundamentally new - the SWORD optic of the French soldier's FELIN system, manufactured by Safran/Sagem, can also be coupled with a head-up display. However, the US Army's new generation of devices is more compact and communicates wirelessly. It can also display information relevant for situational awareness, as well as augmented reality applications. Initial findings from troop trials show that relatively safe hits - an average of 34 out of 40 targets - were possible at over 200 m after a relatively short training period.

ENVG-B and FIWS will also be integrated into IVAS which currently includes a head-up display, an individual central computer, and a radio for data and voice. In the future, this will allow the soldier to access data from more sensors in the network. The US Army also plans to combine IVAS with artificial intelligence and machine learning to create a fully integrated day/night combat capability. Field trials are already underway.

## Outlook

Night vision technology continues to develop rapidly. In January 2021, the research and development agency of the United States Department of Defence DARPA announced its Enhanced Night Vision in eyeglass form (ENVision) pro-



**The US Army's approach of combining ENVG-B und FWSI: Engaging targets from cover**



Photo: US Army

**Rapid target acquisition: Thanks to the wireless interconnectivity with the Family of Weapon Sight-Individual, (FWS-I) the weapon site reticle is displayed in the ENVG-B.**

gramme. ENVision aims to create lightweight NVGs that offer a wide field of view across multiple infrared spectrum bands without needing separate optics for each infrared band. The goal is to enable night vision through fog, dust, and

other obscurants as well as provide thermal vision – all via a single flat lens. Furthermore, night vision technology spreads rapidly. Even today, not only potential near-peer adversaries, but also irregular forces are night-combat capable. Therefore,

Photo: DARPA



**The goal of DARPA's ENVision programme is to enable night vision through fog, dust, and other obscurants, as well as provide thermal vision – all via a single flat lens.**

the question for modern forces is no longer whether night combat capability contributes to battlefield superiority. Rather, the question must be how to achieve night combat

capability as quickly, cross-sectionally and sustainably as possible.

Modern technology can provide superiority. This was demonstrated in US

Army tests comparing the performance of soldiers equipped with ENVG-B versus soldiers using the standard PVS-14 model. The ENVG-B users not only had significantly better imaging, they were also able to engage targets at 300 m, while the comparison group only managed half that.

However, it is not only the equipment, but above all the training that is the key to success. It starts with just operating the equipment, as well as configuring the night vision technology with individual weapons and equipment for the purpose. Field maintenance and care are also part of the process. Individual shooting and combat techniques at night form the next level. This is followed by tactical exercises at the sub-unit, unit, and finally formation level. Of course, this also means moving the training time into the naturally dark hours! But the effort is worth it, because only by mastering the technology and tactics can superior night combat capability be achieved and maintained. ■

### SWIR and eSWIR – devices with future potential

For missions, away from cities or settlements with their artificial residual light sources and with only low moonlight or starlight, many image intensifier night vision devices reach their limits. Here, the ability to detect reflected radiation in the shortwave infrared offers decisive advantages. A natural source of such SWIR radiation is primarily night sky glow, the faint glow of higher atmospheric layers, discovered by astronomer Anders Angström in 1868. Their ability to harness this natural invisible light source makes SWIR devices more powerful than conventional image intensifiers.

LWIR and MWIR sensors, as mentioned, use the heat signatures to display the observed image detail. In contrast, SWIR devices provide images comparable to the visual spectrum, which can be better interpreted by the user and are therefore used to identify objects. Faces or licence plates, for example, can be recognised more easily. SWIR devices also make it easier to detect through fog or smoke. Likewise, and unlike thermal imagers, these devices can also be used to look through window panes.

Bright light or lightning have little effect on the performance of shortwave infrared devices. In addition, SWIR devices - like normal night vision devices - detect common aiming point lasers that operate at wavelengths from 820 nm to 1,060 nm. In addition, they can display all lasers radiating in the SWIR wavelength range (for example, with so-called eye-safe wavelengths around 1,550 nm) and, in turn, use them for illumination or marking.

In terms of SWaP values, SWIR devices offer several advantages, especially compared to cooled thermal imaging devices. For example, only a little energy is required for cooling by cooling machines (Stirling coolers). This results in advantages for battery consumption and operating time. The long-term goal, of course, remains to do away with cooling machines altogether. In addition, SWIR devices are relatively compact and lightweight. The first such handheld weapon sight is the HUNTIRSW from AIM Infrarot Module GmbH, which is still under development. It operates in the spectral range of 0.9 µm and 2.5 µm, and thus in the shortwave and extended shortwave infrared.



**People behind a window - on the left the eSWIR image, on the right a view through a thermal imaging device**

Photo: AIM



# Exhibition & Conferences 2022

January		
15. - 17.02.	International Military Helicopter	London / UK
17. - 20.01.	Surface Warships	London / UK
18. - 20.01.	UTSEC	Nürnberg / Germany
24. - 27.01.	IAV (International Armoured Vehicles)	Twickenham / UK
February		
15. - 20.02.	Singapore Airshow	Singapore
20. - 22.02.	UMEX / SIMTEX	Abu Dhabi / UAE
20. - 22.02.	ISNR	Abu Dhabi / UAE
March		
01. - 02.03.	EnforceTac	Nürnberg / Germany
03. - 06.03.	IWA & Outdoor Classic	Nürnberg / Germany
06. - 09.03.	World Defense Show	Riyadh / Saudi Arabia
08. - 10.03.	DWT – Forschung für Verteidigung und Sicherheit	Bonn / Germany
11. - 13.03.	DEFEXPO India	Gandhinagar / India
19. - 22.03.	IQDEX 2022	Baghdad / Iraq
21. - 23.03.	DIMDEX	Doha / Qatar
28. - 31.03.	DSA / NATSEC – Defence Services Asia	Kuala Lumpur / Malaysia
30. - 31.03.	AFCEA Fachausstellung	Bonn / Germany
April		
03. - 05.04.	Quad A	Nashville, TN / US
04. - 06.04.	Sea Air Space	National Harbor, MD / USA
05. - 10.04.	FIDAE	Santiago / Chile
25. - 28.04.	AUVSI XPONENTIAL	Orlando, FL / US
26. - 28.04.	IT²EC	London / UK
May		
10. - 12.05.	IDEB	Bratislava / Slovakia
10. - 12.05.	Indo-Pacific Int'l Maritime Exposition	Sydney / Australia
18. - 20.05.	BSDA - Black Sea Defense & Aerospace	Bucharest / Romania
24. - 26.05.	Milipol Qatar	Doha / Qatar
31.05. - 02.06.	GPEC General Police Eqpt Exhibition & Conf.	Frankfurt / Germany
June		
01. - 02.06.	CANSEC	Ottawa / Canada
01. - 03.06.	ISDEF	Tel Aviv / Israel
01. - 04.06.	HEMUS	Plovdiv / Bulgaria
07. - 09.06.	SEDEC	Ankara / Turkey
07. - 09.06.	Aerospace & Defense Meetings Sevilla	Seville / Spain
13. - 17.06.	EUROSATORY	Paris / France
21.06.	DWT Dialog Militärattachés	Schloß Diedersdorf, Germany
22. - 25.06.	ILA	Berlin / Germany

July		
05. - 07.07.	Close Combat Symposium	Shrivenham / UK
06. - 07.07.	Intern. Hubschrauberforum (Helicopter Forum)	Bückeburg / Germany
18. - 22.07.	Farnborough International Airshow	Farnborough / UK
August		
TBC	SMDC	Huntsville, AL / USA
29.08. - 01.09.	Defense & Security	Bangkok / Thailand
September		
06. - 09.09.	MSPO	Kielce / Poland
06. - 09.09.	SMM	Hamburg / Germany
20. - 22.09.	CBRNe Protection Symposium	Malmö / Sweden
21. - 25.09.	AAD – African Aerospace & Defence	Tshwane / South Africa
27. - 30.09.	Arms & Security	Kyiv / Ukraine
end Sep.	DWT Marineworkshop	Linstow / Germany
29.09. - 01.10.	Aeronautical & Defence Show	Bordeaux / France
end September	Defence Vehicles Dynamics	London/UK
October		
10. - 12.10.	AUSA	Washington D.C. / USA
18. - 21.10.	EURONAVAL	Paris / France
19. - 21.10.	Future Forces Forum	Prague / Czechia
25. - 27.10.	it-sa	Nürnberg / Germany
31.10. - 03.11.	SOFOX / MESOC	Aqaba / Jordan
November		
02. - 05.11.	Indo Defence/ Indo Aerospace	Jakarta / Indonesia
28.11. - 02.12.	I/ITSEC	Orlando, FL / USA
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