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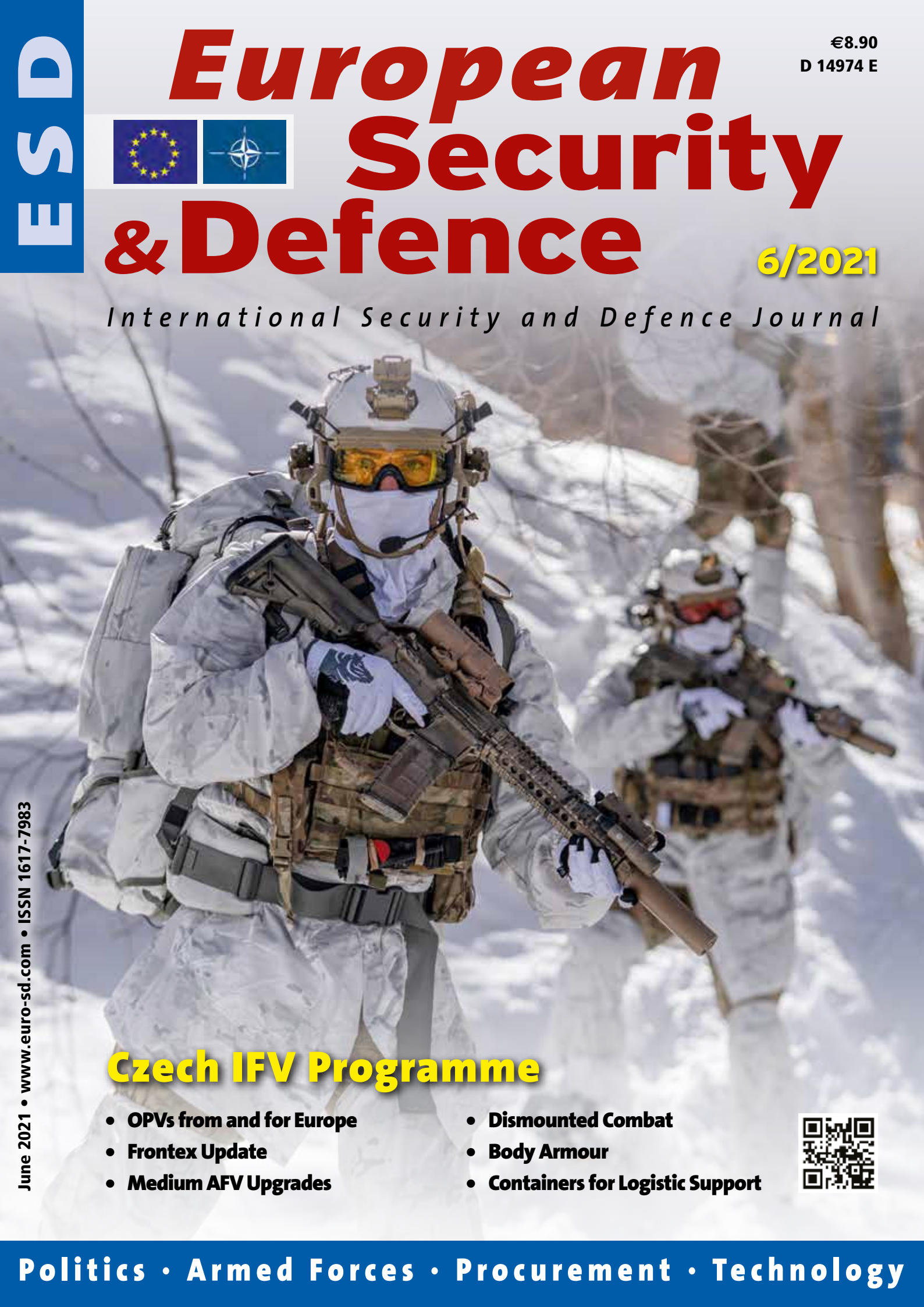

Czech IFV Programme

- OPVs from and for Europe
- Frontex Update
- Medium AFV Upgrades
- Dismounted Combat
- Body Armour
- Containers for Logistic Support

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Afghanistan – Another War Lost?

At the end of April, after almost 20 years in theatre, the United States decided to withdraw its troops from Afghanistan, thus terminating the Resolute Support Mission and completing it – preferably – by 11 September 2021, the 20th anniversary of the 9/11 attacks in the US. As a result, all other western countries with military troop contingents in the country decided to follow suit and also end their military presence in Afghanistan.

Following the announcement of the United States' troop withdrawal, politicians in this country – Germany – rushed to affirm that there was no other alternative for Germany, either, as the stationing of German troops in Afghanistan was only possible with the military support of the American allies.

So far, the mantra of the German Government, as well as NATO, had always been: withdrawal is not linked to calendar dates, but to the situation in-country. The Grand Coalition had just extended the mandate with the main point being that the country would be in danger of descending into chaos and civil war if the troops left prematurely.

Prevention of a civil war – has that been the objective of the mission?

Well, if I remember correctly, there was no mentioning of a civil war threat when the United States entered into an agreement with the so-called "Northern Alliance" (formerly National Islamic Front of Afghanistan), a loose coalition of rival Tajik, Uzbek and Hazara warlords, in October 2001. The objective clearly was to destroy the power of Al Qaida including – which appeared to be the premier objective of the mission to many observers – finding and eliminating Osama Bin Laden as the main suspect of the 9/11 attacks. With strong air support by US troops, the Northern Alliance managed to conquer the country's capital Kabul and the provincial capitals of Kandahar and Kunduz, following which the United Nations' Security Council mandated the International Security Assistance Force (ISAF) to protect the interim government under President Hamid Karzai and to assist in the reconstruction of the country.

When – after months-long global public announcements – the ISAF troops arrived in theatre in December 2001, they were forced to realise that Osama Bin Laden had gone elsewhere and that the rules of war against regular forces could not be applied to the fight against irregular forces like the Taliban and Al Qaida. Within a short period of time, ISAF troops became increasingly involved in combat operations in the South and in the East without, however, achieving a decisive victory. And that has remained unchanged until the present day.

During the early phase of the operation, the German Government avoided using the terms "war" or "combat" in connection with the Afghanistan mission, rather, the operation was advertised as something to – as a German Army major deployed to Afghanistan expressed himself during a TV interview – "dig fountains in fanciful apparel" and thus provide human assistance to the deserving population of the country.

But what has been achieved after all these years? According to NATO, "…ISAF's primary objective was to enable the Afghan Government to provide effective security across the country and develop new Afghan security forces to ensure Afghanistan would never again become a safe haven for terrorists." According to other sources, ISAF's "…main purpose was to train the Afghan forces and assist in rebuilding government institutions."

As we are all well aware, these objectives could not be met, rather, the political situation and development of the country is still decisively influenced by the Taliban and the withdrawing troops, above all, are afraid of forthcoming attacks by the Taliban, in response to which they have assigned special forces units for the protection of that logistic effort.

A recent assessment by the Watson Institute for International Studies at Brown University had the costs invested in the US military's presence in Pakistan, Iraq and Afghanistan at between US$3.2Tr and US$4Tr (US$4,000,000,000,000), of which the Afghanistan share is US$1.1Tr. Taxpayers in Germany invested €12.5Bn. The total number of war victims in the three theatres is estimated at around 360,000, of which 225,000 were in uniform.

Was it worth the effort?

Jürgen Hensel

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Photo: UK MoD

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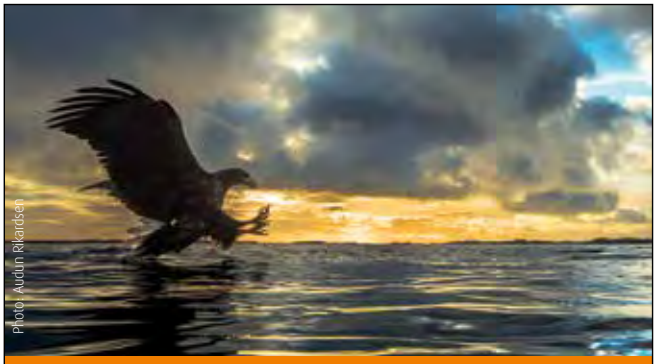

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Incora Opens New Global Corporate Headquarters in Fort Worth

(jh) Incora has announced the opening of its new global headquarters in Fort Worth. Fort Worth was previously home to two company offices, which have consolidated into

Photo: Incora

the new, expanded location. Incora's largest warehouse, by volume, is in the Dallas-Fort Worth area, and some of the company's largest customers and suppliers are nearby.
Consolidating Fort Worth-area offices and assets is part of a global plan to combine two legacy companies, Wesco Aircraft and Pattonair, into one Incora. The integration creates efficiencies, encourages collaboration, and leverages growth in all regions. Incora's executive leadership team will be based in Fort Worth.

Celia Pelaz Joins Hensoldt Management Board

Photo: Hensoldt

(jr) HENSOLDT has appointed Celia Pelaz to the Management Board of the company, a move effective from 1 July 2021. As Chief Strategy Officer, she will be responsible for the strategic positioning of Hensoldt as well as its business development. The company also announced that she will continue to lead the Spectrum Dominance and Airborne Solutions division as well as Hensoldt Ventures. With this step, the Management Board of HENSOLDT will be expanded from three to four members.
Prior to heading the Spectrum Dominance and Airborne Solutions Division, she was Head of Strategic Business Development. In addition to strategic topics, this role included corporate communication, Hensoldt's international businesses and the company's M&A activities. Before that, she held various management positions at Airbus and its predecessor companies. Celia Pelaz holds a degree in Engineering from the Bilbao Chamber of Commerce University (Escuela Universitaria de la Cámara de Comercio de Bilbao).

Rheinmetall Joins UNGC

(jr) Rheinmetall is joining the United Nations Global Compact (UNGC). In becoming a signatory, the company pledges to uphold the 10 principles of the UNGC regarding sustainable and responsible business management and development. Even before joining the UNGC, Rheinmetall oriented its sustainability strategy to the Sustainable Development Goals (SDG) of the UN. For example, the group aims to be CO2-neutral by 2035. In this context, reduced consumption of energy and water is crucial.
The UNGC is the world's biggest sustainability initiative. Enacted by the UN in 2000, it currently numbers 12,765 companies from 160 countries. All of the signatories are committed to running their businesses in accordance with ten universally acknowledged principles relating to human rights, labour standards, environmental protection and combatting corruption. Furthermore, the signatories are obliged to report annually on their progress regarding implementation. Based on the 10 principles and the 17 SDGs, the UN – acting in cooperation with signatories to the UNGC – is working to achieve an inclusive and sustainable global economy that benefits all peoples, communities and markets.

Escribano and GMV Join Sener in the SMS Initiative

(jh) Spanish companies Escribano Mechanical & Engineering, GMV and Sener Aeroespacial have signed a partnership agreement to work together to develop solutions in the area of missile systems and other high-performance guided munitions, as part of the SMS initiative recently launched by Sener Aeroespacial.
The agreement continues the process of consolidating a new national industrial actor that brings together the combined capabilities and experiences of the three companies. As a result, the national industry expects to improve the conditions for its involvement in national and international programmes in the area of missile systems.

Photo: Escribano

EUMET to Develop Engine for NGF

(gwh) MTU Aero Engines (Germany), Safran Aircraft Engines (France) and ITP Aero (Spain) have agreed to jointly develop, manufacture and support the engine for the Next Generation Fighter (NGF), a core element of the Future Combat Air System (FCAS), MTU said in a statement.
To this end, MTU and Safran have founded European Military Engine Team (EUMET) GmbH on a 50:50 basis, which, with ITP as the main partner, intends to provide each partner a one-third share of the work as the sole contractual partner of the nations participating in the FCAS programme. The managing director of EUMET will be nominated by Safran and MTU Aero Engines' Programme Director, Michael Schreyögg, will chair the EUMET shareholder meeting. EUMET's head office will be located in Munich.

Image: MTU

Within EUMET, Safran Aircraft Engines will lead the design and integration of the engine and MTU Aero Engines will lead all maintenance and service activities. As the main partner of EUMET, ITP Aero will be fully involved in the design of the engine and will develop the low-pressure turbine and the nozzle, among other components.
To take the FCAS programme to the next level, the next research and technology phase (R&T 1B/2) is expected to go through the national approval processes by the middle of this year. This is according to the timetable of the respective governments.

BIRD Aerosystems to Open New Office

(jr) BIRD Aerosystems, an Israeli developer of airborne missile protection systems and airborne surveillance, information and observation equipment, is to open an office in Buenos Aires, Argentina. This forms part of the expansion of the company's activities in the Latin American market, the company said in a statement.
The company already has international offices, including Israel, the USA, Cyprus, and Switzerland while establishing another one in Singapore. The new office in Argentina will be responsible for the marketing and business development activities in Central

Photo: Eden Communications

and South America. It will provide maintenance and support services to the company's customers in the region.

Leonardo Buys HENSOLDT Shares

(jr) Leonardo S.p.A. has signed a purchase agreement for 25.1 per cent of the shares in HENSOLDT AG with HENSOLDT's majority shareholder Square Lux Holding II S.à r.l., a portfolio company of investment funds advised by KKR. HENSOLDT will thus gain one additional major shareholder and future potential strategic partner. The sale is subject to the usual regulatory closing conditions. Square Lux Holding II S.à r.l. will still hold around 18 per cent of HENSOLDT after completion of the sale to both Leonardo and Kreditanstalt für Wiederaufbau (KfW), which acts on behalf of the German Government. Square Lux Holding II S.à r.l. had agreed to sell a stake of 25.1 per cent to KfW. As an independent, listed company, HEN-

Photo: euro-sd.com

SOLDT has successfully expanded its leading market position in recent months. As a technology partner and strategic supplier of key national technology, HENSOLDT plays a significant role in decisive areas of the German defence and security sector. The shareholder structure therefore safeguards both German security interests and the independence of the company.

Changes on the Executive Board of Rheinmetall

(jr) Jörg Grotendorst, until now Rheinmetall AG Executive Board member for Automotive, has asked the Supervisory Board to relieve him of his duties. The structure of the Executive Board will be modified accordingly. Following elimination of the Automotive holding and the resulting direct control of all group divisions by the Executive Board, this body will now consist of three rather than four members:

- Armin Papperger, Chairman of the Executive Board of Rheinmetall AG
- Helmut P. Merch (Finance)
- Peter Sebastian Krause (HR).

Citing the prime reason for his decision, Mr Grotendorst stated that due to the strategic reorientation, maintaining a division of responsibilities based on the old separation of the group into Defence and Automotive entities no longer made sense, a view shared

Photo: euro-sd.com

by the Supervisory Board and his fellow Executive Board members. It is felt that a leaner, more agile management structure is necessary in order to bind the two divisions that emerged from the former Automotive organisation – Sensors and Actuators, and Materials and Trade – more closely to the three former Defence divisions, particularly with regard to achieving the sought-after transfer of technology between all group divisions.

Milrem Robotics & XTEK Ltd Reach Deal

(jr) Milrem Robotics has signed a distribution and maintenance agreement with XTEK Ltd. The robotics and autonomous systems developer has also delivered the first THeMIS UGV to the Australian homeland security specialist for trial, evaluation, and demonstration purposes. Including Australia, the THeMIS UGV has been acquired by 11 countries, including Estonia, France, Germany, the Netherlands, Norway, the UK and the US.
Following the signing of an MoU in the end of last year, Milrem Robotics also signed an agreement with XTEK appointing the latter as the exclusive distributor of the THeMIS, the Type-X Robotic Combat Vehicle (RCV), and Milrem's Intelligent Functions Integration Kit (MIFIK) in Australia and New Zealand. XTEK has extensive experience and expertise in unmanned vehicle distribution, maintenance and value-added services.
The company's established maintenance facilities include a Logistics Engineering Busi-

Photo: euro-sd.com

ness Unit based in Canberra. Here, a pool of technicians and trainers with Explosive Ordnance Disposal (EOD) robot maintenance experience can provide maintenance for Milrem Robotics' UGVs and RCVs.
The company plans to leverage its Adelaide Manufacturing Centre and unique XTclave™ technology for novel ballistic protection design, alongside other engineering and manufacturing services, for Milrem Robotics' UGV systems.

New OMFV Teaming Agreement

(jr) Hanwha Defense has signed an exclusive teaming agreement with Oshkosh Defense for the digital design phase of the US Army's Optionally Manned Fighting Vehicle (OMFV) programme. The agreement is followed by Hanwha Defense's recent success in Australia's LAND 400 Phase 3 armoured vehicle modernisation programme and LAND 8116's acquisition of the AS9 Self-Propelled Howitzer and AS10 fully-automated Armoured Ammunition Resupply Vehicle.
The OMFV programme is a key element of the US Army's Next Generation Combat Vehicle modernisation effort that includes replacing the M-2 BRADLEY IFV which has served since the early 1980s. The pro-

Photo: euro-sd.com

gramme's five phase acquisition plan will award the first contract in the fourth quarter of Fiscal Year 2021, with the first units receiving their OMFVs in the fourth quarter of Fiscal Year 2028.
Hanwha Defense is a wheeled and tracked combat vehicle and weapons systems developer in the Republic of Korea with experience, capabilities and technology in proven direct and indirect fire solutions. Hanwha Defense has provided over 7,000 combat vehicles to the Republic of Korea with exports to Estonia, Finland, India, Malaysia, Norway, Poland and Turkey.
Hanwha Defense has designed and is developing the REDBACK IFV for Australia with its enhanced lethality, excellent power, superior situational awareness and best protection in class. The REDBACK was shortlisted in 2019 as one of the two final candidates for the LAND 400 Phase 3 programme, with three prototype vehicles now undergoing tests and evaluations for the Australian Army's Risk Mitigation Activity.

MTU Generators for the US Navy

(jr) Rolls-Royce has been selected to supply its MTU naval generator sets for Phase One of the US Navy's CONSTELLATION (FFG-62) class frigate, previously known as the FFG(X) programme. Rolls-Royce has received a contract for the first ship-set to provide four MTU naval generator sets, each rated at 3000 kWe, the company said in a press release.

The CONSTELLATION class frigate is a multi-mission warship designed for operation in littoral and blue water environments to conduct air, anti-submarine, surface and electronic warfare. The generator sets are based on the MTU 20V 4000 M53B engine and provide a total power output of 12 MW for propulsion and on-board power supply.

The flexible design engineering of the frigate's CODLAG propulsion system is to allow for energy-efficient diesel power generation for propulsion at normal cruising speeds with extended range, while enhancing anti-submarine capability in its quiet diesel-electric configuration. When completed, the lead ship will be nearly 500 feet in length, accommodating up to 200 Sailors and being capable of sustained speeds of more than 26 knots.

Photo: MTU America

Fincantieri Marinette Marine (FMM) of Marinette, Wisconsin, was awarded the build contract for the project, which includes the design and construction of the lead ship and the option to build up to 10 ships in total during Phase One. A potential planned second phase would include another 10 vessels. Construction on the first ship is expected to begin later this year.

ECA Group and TMR Sign MoU for the RAN's MCM Programme

(jh) Australian company Total Marine Technology (TMT) and the French company ECA GROUP have signed a Memorandum of Understanding (MoU) to combine their expertise in the domain of unmanned technologies in order to partner for the SEA 1905 Phase 1 - Tranche 1 programme of the Royal Australian Navy (RAN) for their future Maritime Mine Countermeasures and Military Survey Capability.

Besides, TMT and ECA GROUP are in discussions with other possible Australian partners to further enhance their offer.

Image: ECA

The Royal Australian Navy's SEA 1905 Maritime Mine Countermeasures (MCM) programme was announced in April 2019 to replace the RAN's four remaining HUON class Minehunter Coastal (MHC) vessels. In January 2021, Australia's Minister for Defence also stated that the new ships would be based on the ARAFURA class offshore patrol vessel. The vessels will deploy modular unmanned autonomous systems that will provide them with minehunting and military survey capabilities. The request for tender SEA 1905 Phase 1 - Tranche 1 is expected for the fourth quarter of 2021. Admiral The procurement programme is expected to reach a volume of AU$3.3 - AU$5Bn (€2.1 - 3.2Bn)for the future mine warfare and hydrographic vessels.

Successful LaGS Test

(jr) The SIDEWINDER AIM-9L guided missile's capability has been extended with new laser guidance for use against mobile ground targets. This is the result of a firing campaign conducted by the German Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support in cooperation with the Swedish procurement agency FMV – supported by a team of experts from Diehl defence as the developer and manufacturer.

The Laser-guided SIDEWINDER (LaGS) was deployed from a Saab JAS 39 GRIPEN at the Vidsel firing range. During the second proof firing, a stationary ground target and two moving targets were successfully engaged with one direct hit.

In 2016, Diehl Defence received a development contract for the reconstruction of the AIM-9L SIDEWINDER into a "short-range powered effector" in order to engage targets on the ground. For this purpose, the missile's guidance and control unit was fundamentally modernised. The infrared detector and signal processing of the previous seeker head were replaced by a Semi Active Laser (SAL) sensor with modern digital signal processing.

Photo: Diehl Defence

Diehl Defence has already produced various versions of the US SIDEWINDER in large numbers for European NATO partners since the early 1960s. Today, Diehl Defence's portfolio includes repairs and modernisations for the internationally successful air-to-air missile.

Elettronica to Provide U212 NFS Electronic Warfare Suite

(jr) Elettronica has signed a supply contract with Fincantieri for the Electronic Warfare (EW) suite of the Italian Navy's new submarines. The company said in a press release that this would be done in the framework of the U212 NFS programme managed by OCCAR. The contract includes the provision of two suites for the first batch of platforms and two additional systems as an option for future batches.

Elettronica is already the supplier of the EW equipment in the framework of the FREMM and PPA programmes, also managed by OCCAR, and aims to extend the cooperation to EU co-funded projects. Electromagnetic Spectrum Operation (EMSO) is a key enabler for many diversified operations. In the underwater domain, EMS management and superiority support the submarine's capability to operate without influencing the scenario directly.

Photo: euro-sd.com

Through a very high level of functional integration, the suite is able to perform self-protection, surveillance and intelligence tasks, granting excellent performances on the whole electromagnetic spectrum, from communication to radar bands.

The suite has an integrated RESM/CESM antenna. Two further antennas form part of the system, the first for surveillance and detection tasks in the radar band with the latter as a warning antenna.

Furthermore, the U212 NFS EW suite relies on a software-defined architecture. The EW suite will be provided with an electronic warfare management unit able to collect and manage the information coming from both radar and communications EW sensors.

US Army Announces Divestiture of STRYKER Vehicles

(jh) The U.S. Army will divest all STRYKER Mobile Gun Systems by the end of fiscal year 2022. This decision comes after a comprehensive analysis highlighted obsolescence and systemic issues with the system's dated cannon and automatic loader.

While updating and providing new capabilities is most commonly associated with modernisation, the divestiture of obsolete systems is also an essential component because it frees up resources and manpower that can be applied to other critical capability needs.

USMC Begins ARV Search

(wge) To replace the approximately 600 LAV-25s (Light Armoured Vehicles) in use since the 1980s, the US Marine Corps (USMC) has launched a competitive prototype phase for an Advanced Reconnaissance Vehicle (ARV). The requirement is for a scaleable system platform with an open architecture and growth potential. The ARV is to include a tethered unmanned aerial system with auto-launch and recovery capabilities alongside a robust battlefield management and communication systems. A Lockheed Martin STALKER UAS will be provided for the prototype. The maximum weight requirement is 18.5 tonnes and four vehicles are to be transported simultaneously on a LCAC 100 Ship-to-Shore Connector (SSC).

Photo: Textron

Textron Systems, manufacturer of the LCAC 100, presented its COTTONMOUTH prototype with integrated multi-spectrum sensors on 4 May. The 6×6 vehicle, equipped with two jet nozzles for operations in water, is operated by two people and offers space for five additional personnel. Situational awareness is supported by the "See-Through" technology of Elbit's IronVision system.

The USMC intends to award three contracts for ARV prototypes and then test and evaluate them. Two are to be selected for the Engineering and Manufacturing Development (EMD) phase scheduled to begin in 2024. Subsequent production of the approximately 500 vehicles is to take place over a five-year period.

General Dynamics Land Systems is reported to also have submitted a bid for the prototype ARV. The potential competitor BAE Systems, which already produces the USMC's Amphibious Combat Vehicle, has not yet confirmed a commitment in this regard.

CHALLENGER 3 Contract Signed

(gwh) The CHALLENGER 2 Lifetime Extension Project (C2 LEP) has further developed the UK's MBT to provide the British Army with a state-of-the-art system that will last until at least 2035. The UK MoD and

Photo: RSBL

Rheinmetall BAE Systems Land (RBSL) have agreed on a €930M contract to supply 148 CHALLENGER 3s between 2021 and 2030. Planned IOC for the MBT is 2027 followed by FOC in 2030. For Rheinmetall, this results in a contract value of €770M (excluding taxes), the company stated.

BAE Systems and Rheinmetall had been involved in C2 LEP with separate developments until the activities were merged through the formation of RBSL. After that, there has been only one supplier, who has now been contracted. Four work packages are described in the development contract:

1) For surveillance and reconnaissance, day/night combat capability is to be established with third generation thermal imagers in the observation channels for the commander and gunner.
2) For fire control, a digital fire control system with central computer, control panel and interface to the weapon system.
3) For mobility, hydropneumatic suspension as well as revised air filters, fuel injection, cooling and transmission.
4) For the electronic architecture, a modern data bus for the distribution of video data with interfaces conforming to the Generic Vehicle Architecture (GVA) and improved man-machine interfaces.

In addition – at Rheinmetall's suggestion – the 120-mm smoothbore high-pressure gun L55A1 will be integrated. The gun can fire the ammunition currently offered by Rheinmetall as well as that which will be available in the future – including sub-calibre fin stabilised kinetic ammunition or programmable multi-purpose ammunition.

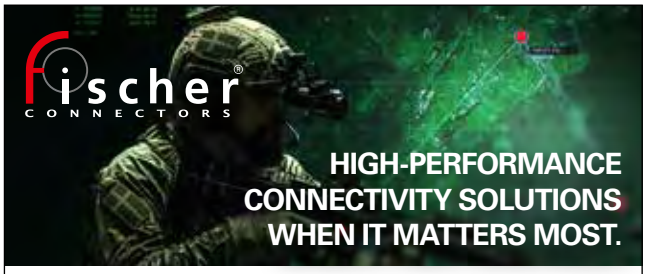
Much of the modernisation work is to take place at RBSL's site in Telford, UK. Rheinmetall Landsysteme GmbH holds 55 per cent of the shares in the RBSL JV, the successor to Vickers Defence Systems, which delivered the CHALLENGER 2 25 years ago.

Rheinmetall Unveils HX3

(jr) Rheinmetall has unveiled the HX3, the latest generation of its HX family of heavy-duty trucks. The company claims that this completely redesigned, future-proof, military truck, addresses contemporary military and automotive trends by drawing on innovative new technologies providing better protection, improved mobility, enhanced driving comfort and a digital interface architecture for greater operational flexibility and future performance upgrades

Photo: Rheinmetall

Like its predecessors, the vehicles of the new HX3 generation are Military-Off-The-Shelf (MOTS) products, designed for military operations.



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The new HX3 generation embodies a platform concept designed for logistic operations and tactical scenarios alike. Thus, the HX3 will be available in 4×4, 6×6, 8×8 and 10×10 versions. New systems such as the fully Automated Load Handling System (ALHS) and Universal Torsion-Resistant Subframe (UTRS) will further facilitate its classic logistics role. Yet, the HX3 is also better able than ever to serve as a systems carrier for complex weapon and radar systems. For example, these include truck-based artillery systems, which are likely to gain importance in coming years. In combination with the newly developed Artillery Truck Interface (ATI), the HX 10×10 could be utilised in future as the standard basis for various artillery solutions or similar systems.

Various assistance systems are to ensure enhanced safety in everyday operations, whether for soldiers deployed in the field or in civilian settings. Coupled with assistance systems such as the Emergency Brake Assist, Adaptive Cruise Control and Lane Departure Warning, a new electronic and electric architecture guarantees has been implemented - with a view to future autonomous driving.

As an option, HX3 trucks can be equipped with an armoured cab, the protection level of which can be modularly augmented. Furthermore, in addition to conventional camouflage, the new generation of vehicles feature a digital stealth mode. If necessary, all data transmission and receiver functions can be switched off to reduce the vehicle's digital signature. As an active self-defence measure, the reinforced roof offers space for weapon stations with heavy weaponry. As a further option, additional active and passive protection systems are available, including Rheinmetall's ROSY Rapid Obscuring System and the very short-range Active Defence System. An identical components concept and a high level of functional commonality between different models facilitate administering and operating the fleet of vehicles. Current international HX user includes Germany, the United Kingdom, Australia, New Zealand and Austria.

Norway and Sweden have also placed substantial truck orders with Rheinmetall.

David Brown Santasalo to assemble power packs for UK BOXER MIV

(jh) WFEL and Krauss-Maffei Wegmann (KMW) have announce an agreement Huddersfield-based David Brown Santasalo (DBS) for the supply of powerpack blocks for the UK BOXER Mechanised Infantry Vehicles (MIV). David Brown Santasalo will assemble around 250 pow-

Photo: WFEL

erpack blocks (transmission, engine and cooling systems), beginning delivery in autumn 2022 and covering a 10-year period of supply.

As part of KMW's UK Boxer Technology Transfer Programme, this particular contract will sustain and create at least 20 jobs in the North of England at David Brown Santasalo (DBS) and its wider supply chain. In the scope of the £30 million order the assembled and tested Powerpack units are delivered to WFEL's BOXER MIV production facility in Stockport for integration.

The BOXER vehicles are provided to the UK MoD as part of the £2.3Bn contract placed with the ARTEC consortium in November 2019.

PRAETORIAN DASS for QUADRIGA EUROFIGHTERSs

(gwh) In the scope of the QUADRIGA programme 38 EUROFIGHTERs will be equipped with the upgraded PRAETORIAN Defensive Aids Subsystem (DASS). Prime contractor Eurofighter Jagdflugzeug GmbH has commissioned the EuroDASS consortium (consisting of Leonardo with Selex ES, Elettronica (ELT), Indra and Hensoldt) to fur-

Photo: Bundeswehr Toni Dahmen

ther develop the protective electronic warfare system and provide it for the new fighter aircraft. In the PRAETORIAN eVo project, the DASS is being completely revised and aligned with future requirements. Next to the engine, DASS is the most financially demanding subsystem of the EUROFIGHTER.

PRAETORIAN is a composite system of antennas, sensors, radar and laser warning devices, decoy launchers, and other decoy equipment distributed throughout the combat aircraft.

The system will be able to detect threats to the aircraft and deploy countermeasures largely automatically. A central Defensive Aids Computer (DAC) evaluates the incoming data, assesses it according to the flight condition, determines the threat using integrated databases, warns the pilot and initiates or suggests countermeasures. The existing DASS system protects the EUROFIGHTER from radar- and infrared-guided missiles. The integrated sensor and jamming equipment also provides situational awareness and enables electronic deception mechanisms.

The open and programmable system allows national operators to have full control over mission data and fine-tune the system to the actual situation on the battlefield. In mission and flight preparation, mission data can be fed into the PRAETORIAN system in a comparably short time.

As part of the Eurofighter Long Term Evolution (LTE) study, EuroDASS is working with Eurofighter partner companies and nations to consider national requirements and how they can be met in an agile and cost-effective way that preserves the EUROFIGHTER's capabilities until it is retired, while supporting the development of future combat aircraft.

In the scope of the QUADRIGA programme, the fourth tranche of EUROFIGHTERs was ordered by NETMA in November 2020. The 38 aircraft are to be delivered from 2025 and replace the Tranche 1 EUROFIGHTERs. Completion of the operation is scheduled for 2030.

FN Herstal Introduces EVOLYS

(jh) FN Herstal introduced a new machine gun named FN EVOLYS during a digital product launch event in early May. According to the company, FN EVOLYS is an unltralight weapon that combines the firing capabilities of a belt-fed machine gun with ergonomics and balance similar to an assault rifle. The gun has been developed in two calibres, namely 5.56x45mm NATO and 7.62x51mm NATO. The weapon has a weight of between 5.5 and 6.2 kg depending on the calibre. Its ambidextrous fire selector has a semi-auto position to engage point targets as with a rifle while the full auto position allows suppressive fire as with a machine gun. The hydraulic buffer provides a steady rate of fire and is said to

Photo: FN Herstal

reduce recoil. EVOLYS has been designed for operation with a sound suppressor and allows for mounting a combination of various in-line optical sights. To avoid a failure while feeding the first round, cartridges are automatically repositioned when the feed cover is closed if the belt is not correctly placed on the feed tray. The last link is automatically ejected, thus enabling fast and reliable reload.

Saab Receives Order for Future Development Support of GRIPEN

(lh) Saab has received an order from the Swedish Defence Materiel Administration FMV to provide future development support for the GRIPEN fighter from 1 April 2021 to 31 December 2022. The total order value is SEK998M.

Photo: Saab

The order is an extension of an existing contract and enables the future development of the GRIPEN for the Swedish Air Force and other GRIPEN users around the world. The contract includes the operating and support of test aircraft and advanced tools such as testing rigs and simulators. Test aircraft together with these advanced tools are used in the verification and validation of GRIPEN C/D and GRIPEN E fighter aircraft.
The main share of the order concerns operations at Saab's facilities in Linköping, Gothenburg, Järfälla, Arboga and Växjö.

More RAFALES for Egypt

(jr) The Arab Republic of Egypt will purchase an additional 30 RAFALE aircraft to equip its air force. This new order complements

Photo: Dassault

the first acquisition of 24 RAFALES signed in February 2015 and will bring the number of Egyptian RAFALES to 54, making the Egyptian Air Force the second in the world (after the French Air and Space Force) to operate such a fleet, Dassault said in a statement. According to press reports, the deal will be financed through a loan to be re-paid over at least ten years.

More BvS10 Vehicles for Sweden

(gwh) The Swedish Army will receive a further 127 BvS10 protected cross-country command and transport vehicles. The Swedish FMV Procurement Agency awarded BAE Systems a €166M contract for the production and delivery of these vehicles between 2022 and 2024. The vehicles will be manufactured at BAE Systems Hägglunds in Sweden.
The amphibious BvS10 consists of two vehicle sections on two tracks each, which are steered via the connecting articulated joint. The crew – four soldiers in the front cabin and eight in the rear cabin – are protected against ballistic and explosive threats. The four wide tracks and the large ground clearance enable the vehicle to operate seamlessly on solid surfaces, over marshy ground and into bodies of water.
With a total weight of about 16 tonnes (loaded), the specific ground pressure is only about half that of most combat vehicles. This allows the BvS10 to operate in areas – rocks, mountains, snow, swamps and arctic environments – that are inaccessible to other vehicles and often to soldiers on foot. The BvS10's modular design allows it to adapt to changing mission requirements.
With this order, Sweden increases its inventory of BvS10s to 277 vehicles. Additionally, Sweden operates several thousand Bv206Ds and Bv206Ss, which date back to a 1970s design. According to BAE Systems, more than 10,000 vehicles have been sold to over 40 countries. Operators of the BvS10 include Austria, France, The Netherlands, Sweden and the UK

Photo: BAE Systems

The new FMV order is not related to the Collaborative All-Terrain Vehicle procurement project, in the sciope of which Germany, the UK, the Netherlands and Sweden, under Swedish project leadership, are looking for a successor to the Bv206 and BvS10. Germany and the Netherlands have estimated their needs at 140 and 124 vehicles respectively from 2024.

INS OZ Handed Over

(jr) Thyssenkrupp Marine Systems (tkMS) delivered the second of four corvettes to the Israeli Navy. The handover ceremony, which was kept small due to the pandemic, took place in the presence of Jeremy Issacharoff, the Israeli ambassador to Germany, and his wife, Laura Kam Issacharoff, who named the ship INS OZ. In the world of shipping, it is a favoured tradition to pass on the names of good ships. With the Israeli Navy, however, INS OZ is the first vessel to receive this name.

Photo: euro-sd.com

The SA'AR 6 class corvettes will form the backbone of the Israeli Navy for the next 30 years. tkMS is building the ships in a joint venture with German Naval Yards Kiel based on a delivery contract for four vessels signed in May 2015. In May 2019, INS MAGEN was christened in Kiel and delivered in November 2020. The two other units of the class are also scheduled for deliveries in 2021. The Israeli Navy will provide the sensor and weapon systems.

HENSOLDT Systems for Dutch FENNEK

(gwh) Krauss-Maffei Wegmann has commissioned HENSOLDT Optronics to supply 188 performance-enhanced observation and reconnaissance systems (Beobachtungs- und Aufklärungsanlage, BAA II NL) as part of the service life extension of the Dutch FENNEK for almost €75M, HENSOLDT said in a statement. The Netherlands is having its reconnaissance vehicles, which were introduced in 2006, modernised in order to extend their service life until at least 2034.

In the course of the modernisation, the number of units will be reduced from 365 to 340. The Forward Observer and Tactical Air Control Party versions will be dropped and Command Post, Driving Training Vehicle and Mortar Carrier versions will be added.

The number of Light Reconnaissance and Surveillance Vehicles (LVB) and Fire Support Team (FST) versions - intrioduced in 2027 - will increase by two to 185 with 138 LVB and 47 FST. These are the only two versions

Photo: HENSOLDT/Carl Schulze

equipped with the BAA II NL. The elevatable observation and reconnaissance system – the central element of these versions – will be equipped with higher resolution cameras. The YellowKite camera is optimised as a day vision/near infrared camera with colour vision with a near infrared (NIR) cut filter as well as a digital output. The entire BAA can be operated on a tripod up to 40 m away from the vehicle.

Automatic motion detection also supports the user during longer missions. The image fusion function combines the data from the thermal imaging camera and the CCD camera into a fused image. A laser rangefinder can be used to determine the distance to targets and terrain points. Laser illuminators and laser pointers are used to mark targets for engagement, such as by laser-guided missiles.

For self-defence with the 12.7 MINIMI machine gun, a new LAZ 400 thermal imaging camera will be installed, doubling the combat distance for precise firing. The smoke launcher will be mounted in a movable position. Automatic motion detection supports the user even during longer missions. The image fusion function combines the data from the thermal imaging camera and the CCD camera into a fused image.

The two FENNEK variants with BAA II NL are the last to be converted in the programme with delivery planned for 2024 to 2027. After that, the refurbished FENNEKs will be available without technical and operational restrictions until the end of their service life.

Airbus Introduces VERTEX

(jr) Airbus is introducing autonomous features to its FLIGHTLAB helicopter demonstrator in the scope of a project code-named VERTEX. The VERTEX technologies aim to simplify mission preparation and management, reduce pilot workload and increase safety.

According to the company, the autonomous technology elements to be integrated include:

- Vision based sensors and algorithms for situational awareness and obstacle detection;
- Fly-by-wire for an enhanced auto-pilot function;
- A touchscreen as an advanced human-machine-interface;
- Head-worn display for inflight monitoring and control.

The combination of these technologies will result in a system that can manage navigation and route preparation, automatic take-off and landing, as well as following a predefined flight path. The incremental integration of these technologies with the FLIGHTLAB demonstrator has begun ahead of a complete demonstration in 2023.

According to the company, it is not Airbus' mission to move ahead with autonomy as a target in itself, but to explore autonomous technologies alongside other technological innovations. In doing so, Airbus is able to analyse the potential to enhance future operations, and at the same time, leverage these opportunities to further improve aircraft safety, the company states. VERTEX is managed by Airbus UpNext, an Airbus subsidiary created to give future technologies a development fast-track by building demonstrators at speed and scale, evaluating, maturing and validating new products and services that encompass radical technological breakthroughs.

Image: Airbus

TopOwl Helmet for NH90

(gwh) The special forces variant of the NH90 transport helicopters will be equipped with Thales' TopOwl digital display system. The TopOwl helmet system uses augmented reality to improve the operational skills of combat helicopter pilots, especially when flying in highly degraded visual environments. TopOwl has also been selected for the Standard 3 upgrade of the TIGER combat helicopter for France, Germany and Spain.

The helmet-mounted vision and display system has been developed over the past 20 years in collaboration with the French Defence Procurement Agency (DGA) and helicopter operators.

It offers high-resolution imaging and live video streaming to extend the helicopter's flight envelope in low visibility conditions. It uses digital technologies and is cyber-secure from the outset.

Pilot fatigue is expected to be reduced with the use of the TopOwl display. Relevant information is displayed in the pilot's field of view. In addition, a spatialised audio warning system, including ambient noise reduction technology, is integrated.

TopOwl also provides flight safety features for non-line-of-sight operations by using a

Photo: Thales

combination of augmented reality, synthetic terrain data and information from 2D and 3D cameras and other sensors. Designed for day and night operations, it supports pilots during landings in extremely degraded conditions, such as brownout, whiteout, heavy fog and dark night operations.
The customised helmet fit system adapts the helmet to each pilot's head shape. The hardware design of the latest TopOwl helmet has been further refined to facilitate integration, reduce power consumption and lower the overall weight.

Babcock's Role in the S-80 Submarine Programme

(jr) Babcock International has assisted its customer Navantia in the construction of the first S-80 class submarine for the Spanish Navy, reaching a major milestone with the unveiling of the boat in Cartagena on 22 April, the company writes in a statement. The S-80 programme is the first modern submarine of Spanish design and is expected to deliver a state of the art underwater capability to the service. Babcock helped to deliver the Weapon Handling and Discharge Equipment (WHDE) and Acoustic Countermeasures Launchers (ACM) for the four boats of the class.

Photo: Babcock International

Throughout design and build stages, Babcock developed a bespoke Spanish supply chain to manufacture a significant amount of equipment for the S-80. The weapon tube outboard lengths and the weapon embarkation equipment were the largest equipment elements manufactured in-country. Babcock will continue to produce a significant amount of equipment in Spain for the remaining boats on the programme. The first submarine, which was unveiled on 22 April, will be named ISAAC PERAL (S-81). It is expected to be delivered in 2022 and be followed by the three other units named NARISO MONTURIOL (S-82), COSME GARCIA (S-83) and MATERO GARCIA DE LOS REYES (S-84).

HENSOLDT to Provide QUADRIGA Radar

(wge) The 38 Tranche 4 EUROFIGHTER aircraft ordered for the German Air Force will receive Active Electronically Scanning Array (AESA) radars from HENSOLDT. Prime contractor Airbus Defence and Space has awarded a contract worth €200M for the production and delivery of radar and core electronic components to the radar supplier, HENSOLDT said in a statement.

Image: Hensoldt

The order is part of the QUADRIGA programme where the first tranche of EUROFIGHTERs will be replaced by 38 new aircraft, which are scheduled for deliveries between 2025 and 2030. Production of the radar systems is to be carried out by a European consortium led by HENSOLDT, with Indra as its main partner. HENSOLDT is investing an additional €30M in the construction of a development centre at its Ulm site, where AI-based sensors for a wide range of applications will be developed in addition to electronic components for the EUROFIGHTER's new radar.
The principle of AESA technology is based on electronic control of the radar beam by a large number of individual transmit/receive modules in conjunction with a multi-channel receiver. This makes it possible to track individual targets and, at the same time, to scan in front of the aircraft over a large area. Thus, with this technology, tasks can be carried out simultaneously during a mission. With the previous mechanical rotating radar antenna, these tasks could only be performed in consecutive order.

First LMV-BR Delivered

(jr) The first of 32 LMV-BR vehicles have been delivered to the Brazilian Army during a ceremony held at the Iveco Defence Vehicles plant in Sete Lagoas. The remaining 31 units of this batch will be delivered by 2022 as part of the Army's modernisation programme. In addition to LMV's well known standard features, all these vehicles are fitted with customised weapon and command & control systems, as required by the customer. The LMV-BR was chosen in 2015 by the Brazilian Army as the new Viatura Blindada Multitarefa, Leve de Rodas (VBMT-LR). The final assembly of the vehicles is carried out at the Sete Lagoas plant, where several national components are integrated. The project foresees the acquisition of 186 vehicles. Iveco Defence Vehicles expects to start

Photo: Iveco

production of the next batches in 2022.
The company is already supplying the Brazilian Army with the GUARANI VBTP 6×6 amphibious armoured family of vehicles. More than 480 units have been delivered since 2012, after the signature of the production contract in 2009. Several units of VBTP 6×6 have been exported to other customers.

LITEF Navigation System for Japanese Helicopters

(gwh) The Subaru Bell 412EPX light multi-purpose helicopter, currently subject to introduction by the Japanese Ground Self-Defence Force (GSDF) as Utility Helicopter-2 (UH-2), will be equipped with Northrop Grumman Litef's LCR-100 navigation system. Over a period of 20 years, the GSDF plans to procure a total of 150 UH-2s.

The LCR-100 Attitude and Heading Reference System (AHRS) uses fibre optic gyroscopes (FOG) in a Micro-Electro-Mechanical System (MEMS). This combination provides an extremely precise and reliable sensor featuring a small volume, low weight and low power dissipation (SWAP).

Image: Litef

The sensors used in the LCR-100 enable autonomous course alignment (gyrocompass). This eliminates the need to use interference-prone magnetic sensors for heading alignment. The LCR-100 can be connected to an external GNSS receiver. In this case, the LCR-100 offers "hybrid position solutions" for navigation and flight control.

Trio of IFVs in Czech Competition

(gwh) The Czech Republic's procurement programme to replace the BVP-2 IVF and the T72 MBT fleets has now entered a new stagfe with the demonstration of technical and tactical capabilities by three contenders. The procurement process has thus picked up speed again after being threatened by delays and even a complete halt.

At the invitation of the Czech Ministry of Defence, BAE Systems has sent the CV90 IFV, General Dynamics European Land Systems the ASCOD IFV and Rheinmetall the LYNX KF41 IFV for testing. The three vehicles have to demonstrate their performance in the field and at the firing range.The tests, which began a few days ago, are to be completed at the beginning of June without any results being announced. After a further inspection loop, the Czech Government will make a decision. It is expected that a call for best and final offers will be issued in time for a procurement contract to be signed this year.

Picture: author/GDELS/PD Jorchr

The number of vehicles required is estimated at up to 210 with a procurement volume of €1.9Bn, with the first vehicles to be delivered by 2023. At least 40 per cent of this is to be provided as value added by Czech companies, first and foremost the state-owned company VOP CZ. With a production rate of five to 10 IFVs per month, production is expected to be completed by 2027.

The IFV programme in the Czech Republic is one of many procurement programmes with which the young NATO members in Eastern Europe are bringing the equipment of their armed forces closer to the standard of their western neighbours and increasing interoperability within NATO. (More details: page 29 pp of this issue).

Hamburg Ship Model Basin Supports F126 Design

(gwh) In the early ship design phase of the F126 class frigate (formerly called Multirole Combat Ship, MKS 180), the Hamburg Ship Model Basin (Hamburgische Schiffbau-Versuchsanstalt, HSVA) is providing support with extensive model test series. This is primarily for the hydrodynamic optimisation of the ship. The general contractor for the F126, Damen Shipyards Group, has opened up access to German know-how with a service contract.

Image: Damen

As part of this process, the properties of the planned ship class are tested under real conditions. Thus, a scale model of the F126 with a length of several metres will be on display for the first time. Over the next few months, the model ship will become subject to a variety of tests at various HSVA test facilities.

In addition to tests to evaluate the ship's drag, propulsion and manoeuvring in smooth water, the ship's sea behaviour will also be looked at and special attention will be paid to a high-quality propeller design. Only through these extensive test series can it be ensured that the high demands placed on the frigates in real-life operations will be met.

The upcoming tests are the most important milestone so far and an indicator of the success of the ship's development, Damen wrote in a press release. Following the test and simulation phase, further development work will be carried out and hundreds of subsystems will be integrated.

Damen will build a total of four F126 frigates for the German Navy together with partners Blohm+Voss and Thales after the company was awarded the contract in 2020 as part of a multi-year European tender. The first ship is to be handed over to the German Navy in Hamburg in 2028. The ships will be designed in Germany, with construction taking place in Hamburg, Kiel and Wolgast.

Russia Developing LANCET UAV for "Air Mining"

(Yury Laskin) The Russian ZALA Aero Group will develop the world's first "air mining" system to destroy hostile UAVs. The group's Chief Designer Alexander Zakharov said that the basis of the new system was the LANCET loitering ammunition. The LANCET has a diving speed of 300 km/h to double the one which is usually employed by the existing UAV. Mr. Zakharov displayed a video with the LANCET being launched from a ground launcher as well as from a mobile platform, such as a vehicle or a boat.

The LANCET is a family of combat drones combat proven by the Russian special operations forces in Syria. The drones were used in multiple successful attacks recorded by their own cameras. ZALA Aero Group has developed several variants of the Lancet UAV, which are in series production.

The LANCET-1 is the smallest family member with a maximum take-off weight of 5 kg, including a 1 kg payload. The flight range is up to 40 km, or 30 minutes at a speed between 80-110 km /h. LANCET-1 has a multichannel guidance system and could be equipped with a TV-camera to transmit the target image for hitting confirmation. The drone has a pre-contact type fuse. LANCET-1 made its public debut at the Army-2020 defence exhibition, but details of the UAV's capabilities were only released in April.

Two other ZALA made UAVs are the LANCET-3 and KUB-UAV which have a take-off weight of 12 kg and are capable of carrying a payload of up to 3 kg.

Photo: Zala Aero

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Protecting the EU's External Borders: An Update on Frontex

Giulia Tilenni

Established in 2004, the European Agency for the Management of Operational Cooperation at the External Borders of the Member States of the European Union, renamed European Border Coast Guard Agency in 2019 and better known as Frontex, monitors and manages the EU's external borders. However, recent scandals are undermining the Agency's ramp-up launched in 2019.

On 11 January, the European Border and Coast Guard Agency presented the uniform of its new standing Corps on Twitter, commenting that "for the first time, the European Union has its own uniformed service". Raising the number of border guards from 5,000 in 2021 to 10,000 by 2027 is among the main innovations introduced with the new Agency's Regulation approved in November 2019. They should help Frontex fulfil its new role of being in charge of European integrated border management and ensure "a high level of internal security within the Union in full respect of fundamental rights, while safeguarding the free movement of persons". To allow Frontex to better meet this objective, its budget jumped from under €100M in 2014 to almost €400M in 2020, with an additional €5.6Bn to be provided between 2022 and 2029.

Author

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Photos: Frontex

The Regulation approved in 2019 was supposed to open a new era for the Agency, which was created in 2004. Events such as the 2015 migration crisis, declared to be over only four years later, and the need to better manage cross-border terrorism and illicit trafficking, have finally convinced the EU 27 of the need of reinforcing external borders for the purpose of enhancing domestic security. Establishing a well-functioning border management system with a clear and smooth asylum mechanism thus became a top priority for European institutions, which has been extensively working to create a dedicated legal framework. Enhancing the role of Frontex, especially in the management of legal and illegal migration, was a logical choice, but its functioning in the last year, especially in the management of the latter, puts this political choice into question.

Managing Legal Border Crossings

According to official figures, non-EU citizens coming from visa-exempt countries account for one third of the crossings registered annually at the approximately 1,885 official external border-crossing points to the EU. With the number of crossings estimated to reach 887 million by 2025, European institutions decided to introduce pre-travel authorisations for citizens coming from about 60

states, UK included, and willing to enter the Schengen area. The European Travel Information and Authorisation System (ETIAS), approved in 2018, is expected to become operational by the end of 2022. Pre-travel authorisations given within this framework will help national authorities gather all the relevant information on travellers before their arrival on EU soil, giving them the possibility to deny the authorisation to travel should this pose a security threat or a risk to public health. ETIAS will cross-check identity data provided by each traveller with those already included in existing information system such as Europol data, the Visa Information System (VIS) and the Schengen Information System (SIS), as well as the Interpol Travel Documents Associated with Notices database (TDAWN). In the future, the list of the database used for this goal will be completed with the Eurodac database and the Entry/Exit system (EES), and dedicated ETIAS Watchlist and specific risk indicators.

Frontex will be in charge of running the ETIAS central unit, which will work 24/7 to verify that each travel authorisation matches with the reference database. Duties will also include the compilation of the above-mentioned Watchlist and risk indicators, the verification of the implementation of existing rules and the protection of the personal data collected. A 250 people-strong staff in Warsaw will likely run the system around the clock.

Next-Gen Border Management: AI-Based Technologies

Having the best information gathering capabilities is crucial for day-to-day border monitoring. State-of-the art, but especially cutting-edge technologies, could be of great help in enhancing the Agency's efficiency. In 2019, Frontex commissioned a study from RAND Europe to assess the main opportunities, challenges, and requirements for adopting AI-based capabilities in border management. In its conclusions issued on 26 March, the study identifies maritime surveillance, facial recognition, and automated border checks as the three fields in which AI could bring more advantages. Analysts have already interviewed representatives of several US and European companies working in this domain that could bring their highly relevant experience to the Agency (i.e. SparkCognition, T3K Forensic, Aeorum and Satways). In the meantime, Frontex has launched calls for tenders to identify relevant programmes, for instance concerning the use of biometric technologies in border checks.

Every year, Frontex organises a photo competition. The winning photo of the 2019 contest is shown, taken by Andrzej Ziobro, showing a Polish border guard.

Illegal Border Crossing

Gathering and sharing information is key for effective border crossing management, especially when it comes to reducing illegal migration, fighting cross-border crimes and protecting and saving migrants at sea (which became an obligation for Member States and Frontex in 2013). The European Border Surveillance System (EUROSUR), a protected communication network allowing for information sharing between the Agency and National Coordination Centres (NCCs) located in each Schengen country, was created in 2013 to respond to this need. Data collected by drones, ships, and the EU's Copernicus Earth-observation satellites on the one hand, and on social media on the other, are fused in "situational pictures" describing the evolution of migrant flows along external land, sea and air border. Frontex, which is responsible for drawing up these pictures, might decide to launch an operation should a potential threat to EU borders emerge. In the light of new rules approved in April by the European Commission to modernise EUROSUR, Member States are required, as of 2 May 2021, to publish regular reports and warnings on relevant and/or potentially dangerous situations, and to systematically report Search & Rescue (S&R) incidents and operations. This should respond to the weaknesses that the European Commission, the European Parlia-

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Frontex officers wearing their new uniform

ment, and the European Court of Auditors identified between 2018 and 2019, which includes limited information sharing from certain Member States and low interoperability of the relevant sharing systems.

Relevant ISR Systems

Every year, the Agency lists the required minimum number of items of technical equipment (MNITE), detailing the assets needed to perform its missions. The list usually includes vessels (offshore and coastal patrol vessels, and coastal patrol boats), fixed wing aircraft, helicopters, vehicles equipped with thermal vision and patrol cars. Recently, more and more funds are allocated for Imagery and Geospatial intelligence (IMINT and GEOINT). Before 2019, these technologies were mainly pledged by Member States on a voluntary basis. But the new Regulations provide space for a different approach. In recent years, Frontex has deployed technologies acquired under service agreements with companies, especially in the field of unmanned technologies. For instance, the Agency has used Leonardo Falco EVO for several trials and some missions, especially at sea, in 2018. Last October, the Agency decided to push its Intelligence, Surveillance and Reconnaissance (ISR) capabilities still further, and concluded a contract with Israel Aerospace Industries (IAI) and Airbus Defence and Space Airborne Solutions (ADAS) concerning the IAI HERON. This Medium Altitude Long Endurance (MALE) UAV will be equipped for pre-planned or ad-hoc missions to be carried out by Greece, Italy, and Malta.

In the meantime, the Agency and the EU have begun to co-fund Member States' acquisition of relevant technologies for ameliorating border management. These procedures have mainly concerned the states located along the so-called 'Balkan Route'. Since 2014, number of thermal-imaging devices and infrared cameras, alongside heartbeat detection devices has sharply increased in Croatia, Romania, and Hungary.

However, ameliorating the quality and efficiency of border control technologies is somehow contributing to tarnishing the image of the Agency. A 2021 report by the Border Violence Monitoring Network (BVMN) claims that enhanced border control technologies have led to increased violence, as police in the Balkans 'weaponise' new equipment against people on the move. Technology used in pushing back migrants has contributed to the way in which "racist and repressive procedures are carried out", the report stated.

The migration crisis in 2015 led to Frontex being strengthened in financial and personnel terms.

The Agency denied any link between the increase in funding of new technologies and pushbacks, but the question is far from being closed.

The Main Wildcard

Since last October, Frontex has been accused of different allegations concerning its internal and external activities. On the one hand, allegations of harassment, and misconduct, which would have led some officials, including high level ones, to quit their jobs. On the other, the Agency is simultaneously accused of mismanagement and unlawful pushbacks of migrants in the Aegean Sea.

The allegations were raised at different times by media outlets. In October 2020, a joint investigation by Bellingcat, Lighthouse Reports, Der Spiegel, ARD and TV Asahi found Frontex's assets to be actively involved in at least four incidents which occurred at the Greek-Turkish maritime border between April and August 2020. The in-depth investigation presented several images and vessel tracking data (AIS and transponder data) in support of their findings.

The EU's Home Affairs Commissioner, Ylva Johansson, immediately called for a meeting of the Agency's Management board, consisting of representatives of the Members States and the European Commission to assess where the responsibilities lay. Multiple enquiries have been launched since. In November, the European Ombudsman, Emily O'Reilly, opened an inquiry upon her own initiative into the Agency's Complaints Mechanism and the role and recruitment of Fundamental Rights Officers. In 2013, Frontex had introduced the two following Ombudsman recommendations from a previous inquiry.

On 7 December, the European Anti-Fraud Office, OLAF, opened an investigation into the Agency as part of the probe into the four above-mentioned allegations. According to officials, OLAF's investigators searched the offices of Frontex Director Fabrice Leggeri and of his Head of Cabinet, Thibauld de La Haye Jousselin.

In January, Frontex announced it had suspended operations in Hungary, after the EU's top court criticised that country's forcible return of migrants to Serbia.

Two days, later, on 29 January, the European Parliament's Committee on Civil Liberties, Justice and Home Affairs approved the creation of the Frontex Scrutiny Working Group (FSWG). The 14 participating MEPs are tasked with assessing the Agency's compliance with fundamental rights, the functioning of its internal management and its transparency and ac-

countability towards the European Parliament. With such a decision, the European institution is implementing Article 6 of the EU Regulation establishing Frontex and affirming its accountability to the European Parliament and the European Council. For the first four months of its activities, officially launched on 23 February, the WG will carry out a fact-finding mission to confirm or deny the allegations of human rights violations. After a meeting with Director Leggeri and Commissioner Johansson in March, the group heard law experts and representatives of NGOs active in Greece and Hungary.

Final Remarks

Growing security threats and the illegal migration flows that have hit Europe in the last decade demonstrate that the approach adopted by the EU 27 when the Schengen Area was created (abolishing internal hard borders without strengthening external ones) was totally wrong. The expansion of the Frontex mandate and the sharp increase in its economic and human resources was supposed to solve the issue by establishing a more coherent and effective management of the EU's external borders. However, the

Frontex`s JOINT OPERATION POSEIDON SEA, which includes the Greek islands in the Aegean Sea and Crete, was tasked with assisting the EU`s frontline states in border surveillance, and in briefing and information activities.

Agency itself is somehow undermining the results of its build-up from the inside.
Ensuring respect of the Agency's code of conduct remains a crucial yet complex issue to address, despite the fact that a dedicated procedure exists. The pattern of recruitment of border guards remains unclear, and the fact that they are selected among national units, each applying different recruitment criteria, does not help.

The first steps of the Agency in its new role are far from convincing. According to its managers though, the reason lies in the fact that the organisation is too small to deal with an increased number of tasks, and especially of border guards. The findings of the different investigations, all ongoing at the time of writing, will probably tell us more about the appropriateness of the Member States' decision.

ECLIPSE – Protection Against Airborne Drone Threats

There is a growing number of counter-UAS options on the market. They are designed to tackle the threats that unauthorised drones pose, such as the targeting of individuals, inflicting physical damage, transporting illegal goods, and stealing trade secrets. However, some of the available products in the market disrupt critical communications infrastructure.
In response to the issue, Israeli NSO Group, a company specialising in cyber technology solutions, developed ECLIPSE, a drone defence system that limits electromagnetic interference and eliminates any potential of physical damage. It casts an unseen electronic dome, which automatically detects, takes over and safely lands unauthorised commercial drones in a designated zone, providing an advanced threat mitigation capability. ECLIPSE is designed to protect dense urban environments, stadiums, critical infrastructure, airports, landmarks, private enterprises, and government facilities. This system can also be used to patrol and secure borders.

Image: NSO Group

How ECLIPSE's electronic dome might appear if it were visible, showing security coverage

NATO Defence Against Terrorism

Dr. Andreea Stoian Karadeli

The terrorist phenomenon has evolved, adapting its narratives and strategies to the global context, especially during the global pandemic. Today, terrorism has no borders, nor geographical limitations, threatening citizens worldwide both in the online and offline space.

Photo: Pxhere

NATO's work on counter-terrorism focuses on improving awareness of the threat, developing capabilities to prepare and respond, and enhancing engagement with partner countries and other international actors.

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Among all the international organisations that have joined forces against the terrorist threat following the September 11, 2001 attacks, NATO is considered one of the most active and experienced actors in combating terrorism. The Alliance's Defence Against Terrorism Programme of Work (DAT POW) reflects its commitment to counter-terrorism and defines, in broad terms, the evolving role played by the organisation in the fight against the complex terrorist threat.

The Evolution of the Terrorist Threat

In recent years, the globalisation of jihadi extremism and the growth in homegrown terrorism, motivated by right and left extremist ideologies, have reflected major developments in the terrorists' strategy and modus operandi: the establishment of a strong connection between terrorist organisations, insurgent groups, and international organised crime; the emergence of homegrown terrorists and "lone wolves" motivated by various ideologies with duplicate tactics; the reliance on complex funding mechanisms; the use of sophisticated audience-oriented propaganda; and access to advanced technologies that can provide the means for unconventional high impact operations. Moreover, the so-called "trinity of terrorism" has made the lines between various group ideologies more blurred, facilitating the symbiotic relationship between the terrorist actors in terms of narrative, strategy and operational tactics. While the Salafi-jihadi terrorist threat has gained authenticity through an omnipresent chimera of a perpetuating virtual Caliphate, the long-ignored threat of homegrown terrorism has struck at the heart of our modern societies, motivated by several extremist ideologies. In this broader context, all the national and international actors involved in counter-terrorism have acknowledged the imperative of developing the capabilities needed to counter these threats.

NATO's Role in Counter-Terrorism

NATO invoked its collective defence clause (Article 5) for the first and only time in response to the 9/11 terrorist attacks. Since then, NATO's work on counter-terrorism has focused on improving awareness of the threat, developing capabilities to prepare and respond, and enhancing engagement with partner countries and other international actors. These three main pillars have provided a more concrete image for the role played by NATO in the global fight against terrorism. While the awareness domain has pointed towards enhancing the exchange of information and intelligence between member countries and/with other international organisations, the engagement field was developed around the Partnership Action Plan on Terrorism, with the aim of contributing to regional stability through capacity-building in partner countries. Equally important at the strategic level, the most pragmatic steps were taken under the capabilities umbrella, aiming to develop innovative technology for the protection of vital assets – only possible through the Defence against Terrorism Programme. This consisted of research programmes for better protection against Man-Portable Air Defence Systems (MANPADs) and CBRN attacks, the detection and destruction of improvised explosive devices (IEDs), the development of biometric identification systems, and the promotion of cultural awareness in deployed troops. Moreover, training and education through a researcher/scholar-practitioner bridge and lessons learned were attributed to the NATO's Centre of Excellence for the Defence against Terrorism in Ankara.

NATO Defence Against Terrorism

In order to pragmatically define and determine NATO's role in the international community's fight against terrorism, DAT

POW was developed by the Conference of National Armaments Directors (CNAD) and endorsed by NATO Heads of State and Government at the Istanbul Summit in June 2004. According to official statements, the aim of DAT POW is to prevent non-conventional attacks, such as attacks with IEDs and unmanned aircraft systems (UAS), and mitigate other challenges, such as attacks on critical infrastructure.

As a unique programme built on the principle of common funding, DAT POW is the key-fast route to capability development in the field of counter-terrorism. Under the DAT POW initiative, individual NATO countries, with the support and contributions from other member countries and NATO bodies, lead projects to develop advanced technologies or counter-measures which meet the most urgent security needs in the face of terrorism and other asymmetric threats. Although its primary focus was on technological solutions to mitigate the effects of terrorist attacks, the programme has since widened its scope in line with the current global and regional threats, to support comprehensive capability development and includes prototypes and concepts, doctrine, policy, equipment, training and lessons learned, exercises, trials, and interoperability demonstrations. Based on an internal assessment, most projects under the programme focus on finding solutions that can be fielded in the short term and that respond to the military needs of the Alliance. The programme uses new or adapted technologies or methods to detect, disrupt and defeat asymmetric threats, covering a wide range of areas, including C-UAS, biometrics, technical exploitation and C-IED. DAT POW is also an integral contributor to NATO Science & Technology activities and as such, contributes to the ongoing efforts in the field of emerging and disruptive technologies. NATO's DAT POW specifically addresses critical counter-terrorism capability deficiencies, focusing on the most critical terrorist threats through three capability umbrellas: incident management, force protection/survivability, and network engagement.

Photo: NATO

NATO cooperates with partners and international organisations to leverage the full potential of each stakeholder engaged in the global counter-terrorism effort.

Photo: US Army

Biometrics uses physiological features, such as fingerprints or iris scanning, as a method of.

The Incident Management Umbrella

The incident management umbrella comprises initiatives to improve organisation and coordination in dealing with a terrorist incident, namely protection of harbours and ports and critical infrastructure protection.

Based on the programme of work developed by the Alliance, the safe and uninterrupted functioning of harbours and ports is critical to the global economy; it is essential for maritime assets to be made as secure as possible. So far, various technologies have been explored to enhance maritime protection, such as sensor nets, electro-optical detectors, rapid-reaction capabilities, underwater magnetic barriers and unmanned underwater vehicles. In 2018 and 2020, under the leadership of France, the DAT POW supported "Cut Away", a multi-national harbour exploration and clearance exercise. Additionally, under the lead of the NATO Centre for Maritime Research and Experimentation (CMRE) located in La Spezia, Italy, the DAT POW is assessing the use of underwater autonomous systems to detect maritime IEDs and of virtual reality for situational awareness.

The Force Protection/ Survivability Umbrella

The force protection/survivability umbrella covers initiatives to improve "all measures and means to minimise the vulnerability of personnel, facilities, equipment and operations to any threat and in all situations, to preserve freedom of action and the operational effectiveness of the force": Large Aircraft Survivability against MANPADS; Countering Improvised Explosive Devices (IEDs); Detection, Protection and Defeat of Chemical, Biological, Radiological and Nuclear (CBRN) Weapons; Explosive Ordnance Disposal (EOD) and Consequence Management; and Non-Lethal Capabilities (NLC).

In terms of Large Aircraft Survivability against MANPADS, exercises and tests are organised annually to improve systems and equipment. Among the member countries, the UK is the lead nation for this initiative and the NATO Air Force Armaments Group (NAFAG) has provided critical expertise and support to the annual field trials. As a supporting nation, France is conducting trials to complement the work carried out by UK and NAFAG.

NATO's effort in countering IEDs is led by several bodies including the Counter Improvised Explosive Devices (C-IED) Centre of Excellence in Madrid. Various technologies to defeat IEDs have been explored, in particular stand-off detection. The biennial "Thor's Hammer" electronic counter-measures trial series and the radio-controlled IED database are two innovative approaches supported by the DAT POW, which are now also being leveraged to support efforts at countering unmanned aircraft systems.

DAT POW supports the Alliance's overall ability to meet these commitments through projects covering detection, identification and monitoring of CBRN substances, CBRN information management, physical protection, hazard management and CBRN medical countermeasures. DAT POW also supports training and exercises, including those conducted with live agents. DAT POW has also supported the Joint CBRN Defence Centre of Excellence in Vyskov, Czech Republic, in establishing and enhancing its CBRN Reach Back capability, such as ensuring CBRN expertise is available to the NATO Command Structure and Allied forces in theatres of operations.

The Explosive Ordnance Disposal (EOD) and Consequence Management domain aims to improve NATO's capabilities through the training of explosive ordnance disposal (EOD) teams and optimised management of the consequences of an explosion. DAT POW supports NATO EOD demonstrations and trials, led by the NATO EOD Centre of Excellence in Trencin, Slovakia. With DAT POW support, the demining community has also tested integrated exoskeletons.

The Alliance has stressed the need for better response capabilities to minimise collateral damage. If forces can only respond in a lethal manner, civilians and military alike are endangered, and mission failure or political fallout may result. Under the lead of Belgium, Canada and the United States, DAT POW sponsored the demonstration of the use of non-lethal weapons in different environments.

Photo: NATO

In June 2020, NATO launched its first ever Counter-Terrorism Reference Curriculum (CTRC). It supports interested allies and partner countries in enhancing their capacities to develop national skills and improve counter-terrorism strategies.

The Network Engagement Umbrella

The network engagement umbrella covers initiatives to improve identification and targeting of key nodes of Threat Networks: Technology for Intelligence, Surveillance, Reconnaissance and Target

Acquisition (ISRTA); improving standardisation among the Human Intelligence (HUMINT) community; and biometrics.
The ISRTA initiative focuses on the development of improved tools for early warning and identification of terrorists and their activities. To build on the improved intelligence/information sharing achieved over the past decade in common operations and to capture these developments for the future, DAT POW supported Unified Vision Trials (2012-2014), organised by the joint capability development group ISR. Simulating a real–world operational environment, the trial sought to determine how well participants could analyse threat information and identify and track threats to form a cohesive intelligence picture and how easily this could be shared.
DAT POW also supports improving technical interoperability within the NATO HUMINT community and the ability to analyse human aspects of the operational environment where NATO forces operate under the lead of the HUMINT Centre of Excellence (COE) in Oradea, Romania. Key milestones include the delivery of human aspects of the Operational Environment Study and the development of the HUMINT Operator Toolset (NHOTS).
Last, but not least, biometric data are essential to protect forces in theatre, allowing them to identify known or suspected insurgents. NATO's Strategic Commands have recognised that developing and improving this area is a military requirement. NATO's biometrics programme of work and action plan cover all the areas required for a full capability (doctrine, concept, standards, equipment, etc.). In recent months, NATO's work on biometrics hit two important milestones. In September 2020, the NCI Agency hosted a pilot of a new exercise focused on biometrics – NORTHERN SPIRIT 20. Shortly after, the Agency hosted a two-day workshop on biometrics in The Hague. NATO's Emerging Security Challenges Division, through its Defence against Terrorism Programme of Work, sponsored both events. During both the exercise and workshop, the participating nations used a system developed by the NATO Communications and Information Agency: the NATO Automated Biometrics Identification System, or NABIS. Based on official information, the NABIS system has a concept called "ping and ring" in place to allow nations to share data only when necessary, while protecting the sources of that data. If a nation collects biometric data and needs more information to identify that person, they can "ping" the system to see if nations have a match. Nations can then "ring" the nation asking for data if they have something that could help them. The NABIS system allows them to share this data in a secure manner. Nevertheless, the DAT POW community also supported an initiative to develop a biometrics capability in a maritime environment.

Counter-Terrorism Education and Training

Throughout the Alliance's counter-terrorism struggle, the vital importance of education and training in the field has been acknowledged and promoted within NATO's DAT POW. So far, NATO has offered a range of training and education opportunities in the field of counter-terrorism to both Allies and partner countries, through a wide network that includes the NATO School in Oberammergau, Germany, mobile training courses run out of Joint Force Commands at Naples and Brunssum and the Centres of Excellence (COEs) that support the NATO Command Structure. There are more than 20 COEs accredited by NATO of which several have a link to the fight against terrorism. As a vital component in this fight, the Centre of Excellence for Defence Against Terrorism (COE-DAT) in Ankara, serves both as a location for meetings and as a catalyst for international dialogue and discussion on terrorism and counter-terrorism. Based on personal professional experience as a lecturer and course academic adviser at COE-DAT, I am honoured to have had the chance to share my expertise, and must emphasise the relevance of the centre in building a bridge between scholars and practitioners in CT, and enlarging the knowledge in the field in a multi-disciplinary manner, based both on theoretical and ground experience. The evolution of terrorism and its diverse forms pushes the CT actors to reach beyond the traditional boundaries of their domain and find strong allies among the academic field. While no one side possesses the whole truth, the scholar-practitioner cooperation can provide both short- and long-term solutions for the counter-terrorism strategy, while developing a spherical understanding of the subject. Moreover, COE-DAT can and should serve as a great platform for developing a common understanding of terrorism as a concept, fully accepted by all the member nations.

Photo: NATO

With the "Northern Spirit 20" exercise, NATO sought to practice sharing biometrics and identity information in a scenario that would simulate several NATO-led operations taking place at the same time at sea, and on land.

NATO's 2020 Counter-Terrorism Reference Curriculum

Speaking of terms and concepts, in June 2020, NATO launched its first standardised Counter-Terrorism Reference Curriculum. A result of a scholar-researcher-practitioner team, the reference curriculum provides a multi-disciplinary approach that helps learners develop the knowledge and skills needed to understand terrorism and counter-terrorism

Photo: NATO

Vehicle-borne IEDs are one of the main causes of casualties among troops and exact a heavy toll on local populations.

in order to successfully anticipate and mitigate potential threats. The 2020 Reference Curriculum addresses current challenges at the theoretical, operational and technical levels. While the curriculum does not claim to provide all the answers, its aim has been to highlight foundational and informative material and structures through which ideas and strategies can be developed.

The Reference Curriculum acknowledges that the study of terrorism and counter-terrorism is a methodologically diverse field, replete with debate, extending even to fundamental definitional discussions. In this regard, the curriculum admits that disagreements persist concerning an accepted legal definition of terrorism, due to the fact that different countries have different experiences with terrorism that have shaped their separate understandings. Still, the curriculum makes an important theoretical distinction between 'terrorism' and 'terrorists'; while the features of terrorists change according to circumstance, the features of 'terrorism', such as the importance of ideology, remain constant. At the operational level, further challenges persist, as states are forced to essentially calculate the degree of risk with which they are comfortable, juxtaposed against the potential impact of a successful attack. The international community has recognised that establishing a common definition of terrorism is required. A standard definition allows an effective coordinated international response to terrorism that adopts pragmatic approaches and marshals all instruments of government and society in order to combat it.

Pitfalls and Recommendations

Acknowledging the active role played by NATO in the global fight against terrorism since 2001 and recognising the progress achieved by the Alliance in transforming its role and capabilities according to the needs of the global counter-terrorism struggle, there is still place for improvement in order to enhance NATO's DAT POW potential.

Firstly, due to its nature, NATO is mainly focused on the fight against terrorism from a military perspective. It is important to emphasise that the fight against global terrorism can only be successful if comprehensive, international, multilateral action is taken, which includes military operations, in addition to political, economic, legal, diplomatic and social tools. Although DAT POW reflects the Alliance's commitment to develop counter-terrorism capabilities beyond the military aspect, the evolution of the terrorist threat creates the need to adapt and develop the CT strategy to be one step ahead of the terrorist groups.

Secondly, both the Alliance and the international cooperation between NATO and the European Union in the field of counter-terrorism will benefit from the development of a common definition for terrorism that can set the stage for a common CT defence policy understanding. Whether within the EU or NATO, the ambiguity of the term 'terrorism', the corresponding limits of these organisations' strategies, the minimal political will of member states, and numerous horizontal non-institutional arrangements, all make counter-terrorism policies less consistent and hamper the development of a more strategic approach. Subsequently, these factors need to be addressed in future policymaking.

Thirdly, the particular focus on jihadist terrorism and the Middle East hinders the potential for a global, inclusive counter-terrorism strategy. In this regard, the Alliance should equally focus on home-grown terrorist threats, while remaining vigilant to the threat outside of national borders. Therefore, NATO should further establish and develop the direct link between its broader efforts and homeland security.

Since 2001, NATO has rebranded its defence role, adapting it to the current terrorist threat. Later on, in order to enhance its role in counter-terrorism, NATO's DAT POW should develop prevention capabilities, while it continues to support the current capabilities and technologies. Nevertheless, NATO should enhance education and training to build more effective local security forces in a crisis like Iraq, Afghanistan or Libya in order to prevent a security vacuum after the troops' withdrawal. At the cooperation level, NATO should focus on dialogue and cooperation with its partners – EU and UN – for complementary capabilities that can increase the overall potential of the global counter-terrorism action. Also, bearing in mind the current threats, NATO should rethink Article 5 in order to determine how NATO could defeat and respond to the cyber and hybrid attacks in Collective Defence relations according to the actual Treaty.

Counter-terrorism is undoubtedly a complex task and NATO has proved its potential as an experienced actor in the field. NATO DAT POW has been developed as the key-fast route to capability development in the fight against terrorism. Still, as terrorism is continuously evolving, becoming more dispersed, decentralised, and multi-faceted, NATO is also forced to change and adapt its strategy, capabilities and tactics accordingly. ■

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Syria in 2021: A Transition Conflict with no Lasting Resolution

Dr. Andreea Stoian Karadeli

The Syrian War reflects all the weaknesses of our modern society, affecting neighbouring countries, the region and the overall international scene. After ten years of bloodshed, there is no resolution to the crisis. The current ceasefire in Idlib is a fragile step towards peace and stability, but a long way from a long-term solution.

"It's your turn next, doctor!" was the line that ignited the "Syrian Spring" in March 2011. Written on a school wall by a group of students - a reference to the previous career of Syrian President Bashar al-Assad - the graffiti triggered a domino of events that echoed dangerously in a war on real and virtual grounds, with mixing actors of power politics, changing interests and, thus far, no real winner - only thousands of defeats.

The Syrian crisis evolved as a transition conflict, bridging the post-1989 national or regional crisis to current international confrontations such as the Nagorno-Karabakh conflict and the Taiwan Strait. Syria became a battleground not only for Syrian internal unrest, but for an overlapping of power competition and terrorism issues with regional and international reach. Therefore, the Syrian War should never be seen or analysed purely as a national/regional crisis, but rather as a physical intersection of global issues. As a result, ten years of conflict have not only destroyed a country, but the consequences have been felt at the wider regional level by all neighbouring countries, and also on an international scale, by the whole world.

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Photo: via author / CC/ Christiaan Triebert

Two destroyed tanks in front of a mosque in Azaz to the north of Aleppo in Syria

The Syrian Struggle and the Terrorist Nexus

As the Arab Spring spread throughout the region, protests were also triggered in Syria by the arrest, torture and eventual death of some of the teenagers who painted the school-wall graffiti denouncing country's long-time president, in the city of Deraa. What started out as peaceful protests, slowly turned into violence, bloodshed and, eventually, civil war. The response of the Assad regime led to the creation of the Free Syrian Army in July 2011, a rebel group formed by defectors from the military, aiming to overthrow the government, turning the revolt into a civil war. While the internal struggle intensified, various rebel groups of different ideological affiliations, mostly Salafi-jihadi, have emerged across the country, seizing the opportunity represented by the security and stability vacuum in both Iraq and Syria. Later on, in 2013, Daesh formally emerged in northern and eastern Syria after overrunning large portions of Iraq. From that moment on, the Syrian struggle for peace and democracy turned into repression, bloodshed and a fake "Islamic Caliphate".

As the peaceful Syrian protests turned into a perfect opportunity for the terrorist Salafi-jihadi groups, the evolution of the war has been the result of disastrous internal/national decisions, external/international mismanagement of the crisis and lack of a long-term vision. The channels for foreign fighters to join extremist groups in the region were created back in 2003, facilitating the movement of not only Syrians, but also foreign fighters—primarily from the Arab world—into Iraq. Although the Salafi-jihadi groups were weakened in Iraq after Zarqawi's death in 2006, the Arab unrest, the protests in Syria, the American

troop withdrawal in 2011, and some of Assad's poor decisions helped the "global neo-jihad" reorganise and reach its highest achievement – an Islamic Caliphate in the region of Iraq and Syria.

When the "Syrian Spring" first ignited in early 2011, the Assad regime took two decisions that tipped the balance in favour of Salafi-jihadi groups. At first, the regime's forces responded to the protest movement with extreme violence, imprisoning and torturing the key persons responsible for mobilising the masses. Then, by the end of 2011, as part of its amnesty programme, the Assad regime released from prison former Syrian Islamists and jihadists who had fought against the United States in Iraq. Just as a parallel, the operation "Breaking the Walls" undertook by AQI in 2012-2013 helped release Iraqi individuals with extreme views who further join the ranks of the fake Caliphate. While the Saidnaya detainees in Syria suppressed the original protests, their message, and their internal calls for peace and democracy, providing a platform for militant extremism, the Abu Ghraib detainees in Iraq restored its ranks with hundreds of previously detained, skilled operatives, setting the stage for its resurgence and the transition into the Islamic State of Iraq and Syria.

Daesh was officially defeated in Syria in 2019, but related cells and underground networks have survived ever since, waiting for the right moment to make a comeback. While the war itself is paused, but not over, reconstruction efforts are needed at both infrastructure and society level. In other words, it is not just the roads and buildings of Syria that are in ruins as the result of 10 years of clashes, but a whole nation is displaced internally and externally, wrecked by trauma, fear and loss. The Syrian refugees are now spread among several countries: 6 million internally displaced, 1.5 million in Lebanon, 3.6 million in Turkey, 700,000 in Jordan, 250,000 in Iraq and lower numbers in Europe and other regions. Unlike any other conflict before, rebuilding Syria represents, in fact, the rebuilding of our common future for peace, security and stability at the global level.

Photo: via author / CC

Syrian refugees are now spread among several countries.

Hunger, Enclaves and Incendiary Terrorist Ashes

The total cost of the war to the Syrian economy is estimated at around €1Trillion. According to the World Bank, the Syrian economy has shrunk by more than 60 per cent since 2010, and the Syrian pound has crashed. Pre-war, the Syrian pound traded near SYP50 to the US dollar. As of January 2021, it was formally trading at over SYP1,250 and informally at over SYP3,000. This equates to a 300 per cent inflation rate increase on consumer goods. Beyond the war and the internal corruption of the Assad regime, the 2020 Lebanese cash crisis has also accelerated Syria's economic collapse. Unemployment was high before the war and only worsened throughout the conflict. Additionally, the Syrian middle class, which comprised 60 per cent of Syria's population in pre-war years, has now been reduced to 10 to 15 per cent.

In the first quarter of 2021, the World Food Programme reported that, in Syria, 12.4M people are food insecure and 1.3M people are facing severe food shortages. A total of 13.4M people, out of a total population of 17.5 million, is in need of humanitarian assistance. Based on several official reports of organisations involved in the region, if no action is taken, another 1.8M Syrians could become food insecure, reinforcing the urgency of the WFP's US$375.3M funding appeal for the summer of 2021. The vast majority of the 8M locals and refugees living in Damascus now rely on food boxes and lack basic needs such as electricity which is only available four hours daily. Moreover, half of the children growing up in Syria are out of education according to a UNICEF statement issued on 24 January 2021: "Inside Syria, there are over 2.4 million children out of school, nearly 40 per cent are girls."

While the whole world is facing the pandemic, over 12M Syrians were in need of healthcare support at the beginning of 2020; this number is estimated to be higher in light of Covid-19. The pandemic situation is particularly bad in a country lacking medical infrastructure and funding required to combat a pandemic. Official government numbers currently stand at roughly 16,000 cases and 1,045 deaths, but real statistics are expected to be much higher due to weak testing capacity.

Among poverty, hunger, unemployment, shortage of basic needs, lack of medical infrastructure in the time of a deadly virus, terrorist groups are still a threat to the fragile ceasefire. Since 2019, Daesh has remained underground in Syria, preserving itself in the mountains and caves of the Badia. While many of its frontline foreign fighters coming from North Africa and post-Soviet republics have battleground experience against both the regime and SDF, they have now gained valuable experience as insurgents as well. As a pattern repeating itself, the group has never been completely defeated, and found an opportunity to further develop in the form of an insurgency. There are, in fact, several indicators that point to the increasing threat represented by the group: the capability to launch attacks of small, medium and big scale on Syrian territory, the weakening of local/regional adversaries, and an increasing influence over the local population.

Daesh's offensive activity in Syria has been on the rise since 2019, and the number of attacks reached the highest level in January 2021. The numbers and quality of the attacks prove that the group's offensive capability remains quite strong, forcing the regime's military units and their allies to stay alert. While Daesh militants and supporters prove highly committed to their cause, the security forces in the area have proved unable to protect the towns. Attacks are just the reflection of Daesh's increasing power that is also infiltrating once again among the local population. According to several international reports, in rural areas of the Badia, the group often imposes mafia-like governance by extorting businesses, shep-

Photo: via author / Wiki CC

The Syrian Spring began in 2011 with large demonstrations against the regime of President Bashir Al Assad.

herds, and other locals. In response to not obeying the rules imposed by the group, locals face death, abduction, or confiscation of their property. Unfortunately, neither the regime nor the SDF has done much to prevent these abuses. Among the many tribal and community leaders who have been targeted for working with the SDF, an elder of the Ougaidat tribe was killed in January. And on 13 March, Daesh released a list of inhabitants in the Deir al-Zour village of Jadid Ougaidat, threatening to kill them and destroy their homes if they did not comply with their requests.

Bearing in mind the Salafi-jihadi interest in prisons, detainees and camps that can provide human infrastructure to serve their goals, Syria still represents an obvious target due to the high concentration of Daesh supporters in both al-Hawl camp and Hasaka Central Prison. Based on information obtained by international humanitarian organisations, beheadings, point-blank executions with silenced pistols, and other killings have become increasingly common in al-Hawl camp. In the first quarter of 2021, 41 murders have been confirmed, while 33 incidents were registered in 2020. Nevertheless, connections to the outside are growing as well, facilitating camp residents' access to weapons and cell phones.

According to the latest reports from the Institute for the Study of War, Daesh faces pressure along multiple fronts as it begins its annual Ramadan surge of attacks in Syria. Al-Qaeda affiliate Hay'at Tahrir al Sham (HTS) mounted counter-Daesh operations targeting leadership cells in Idlib, likely in order to both depress Daesh's attack capability and to distance HTS from other "hardline" Salafi-jihadi organisations. The British Royal Air Force and the Russian military similarly conducted precision operations, possibly intended to target high-value Daesh leadership figures in eastern Syria. The US-partnered Syrian Democratic Forces (SDF), meanwhile, secured camps and detention centres housing former Daesh affiliates in order to prevent it from staging a prison break during the coming months. Still, Daesh is expected to continue to conduct large-scale but disparate attacks on oil and gas facilities in the Central Syrian Desert and attacks targeting civil society leaders, exploiting existing Arab-Kurdish divisions, in SDF-held northeast Syria.

The Premises for Coming Years

In the first months of 2011, I was a resident of Damascus, following the developments of the Arab Spring and never expecting a ten-year conflict to unleash the chaos that followed. I left Syria in the summer of that year but dedicated my academic career to the struggle against the terrorist groups that were born out of the "Syrian Spring". As I write these lines weighing up the past ten years, I must emphasise that there is no possible way to reconstruct all that was lost in the Syrian War since 2011. The personal, cultural, social, economic, historical, psychological, humanitarian, political, diplomatic, military and, nevertheless, egocentric dimensions of the crisis are a burden that is felt globally today. In respect to all the things that may never be recovered from the lost "Syrian Spring", the global community should put aside the old and new games of power politics and join hands to rebuild a secure and stable Syria. The international struggle that Syria needs is, in fact, a struggle for ourselves and for global peace. Otherwise, future current and future conflicts that will emerge will be even harder to manage.

To conclude, there are three elements central to rebuilding Syria. Firstly, there is no Syrian future that can include the current regime. As the Arab League is currently building momentum to reintegrate Syria (suspended in November 2011), such a step should never be taken with Bashar al-Assad as president. This will only turn a blind eye to the regime's actions against the Syrian people. A regime that is not able to defend its people should never be left in place. Nevertheless, once a regime change has been achieved, the new political figures need to gain, from the very beginning, the trust and support of the Syrian nation to start the long and rocky road towards security and stability. Secondly, international actors need to come together to eradicate all terrorist groups on the ground, disregard their affiliations and affinities. The underground persistence of those groups should also be tackled. The camps and prisons are in urgent need of reorganisation, and their security infrastructure has to be rebuilt in order to prevent any infiltrations or attacks. Thirdly, as the first two goals are achieved, a new and stronger Syria can flourish from within, through its own people. The international community needs to ensure that the Syrian people who are now displaced around many nations will be able to return to a safe home. None of these three elements is achievable unless all the actors involved are determined to support the interests of the Syrian people. To continue gambling with Syria's future would only mean threatening the peace, security and stability of our modern world. ■

. Photo: MoD Russia

The total cost of the war to the Syrian economy is estimated at around €1 trillion.

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In the Czech Republic, a source for spare parts for PUMA and LEOPARD 2 is already subject to qualification and Ray Service in Staré Město will be qualified for final assembly of the tracks.
DST is focused on looking for potential suppliers of track parts for localisation concepts in Hungary and the Slovak Republic, too.

Photo: Rheinmetall

Photo: GDELS

DST has a long tradition in cooperating with most international armoured vehicle manufacturers and thus takes advantage of trustful and worldwide reliable partnerships.
In recent times the IFV market has been subject to a step change - the requirements are no longer just for vehicles to serve as armoured personnel carriers, rather capabilities and features comparable to those of main battle tanks are in demand.
This development has resulted in a significant increase in the weight of the vehicle platform, thus taking state-of-the-art mechanised combat vehicles into the 40-50 metric tonnes range.
In response to the new challenge, DST has developed a track design that is superior to anything else on the market.

DLT-464 – the Track of Choice

With a specific focus on the current Czech tender for a future IFV, DST Defence Service Tracks GmbH tracks have been integrated with two competing vehicles since the very beginning of the programme trials.
Three out of four contenders (LYNX, ASCOD and PUMA) that participated in the first trials in 2018 went into the race on a DST track.
The final trials in the Czech Republic are currently ongoing with two out of three vehicles vehicles, with superior performance in the German Army's preparation for VJTF participation. Further life tests under severe conditions have been successfully completed on AJAX/ASCOD vehicles.

Cooperation and Local Production

DST's strength is to collaborate with vehicle manufacturers and provide a track solution to meet the end users' requirements.
Apart from the product portfolio, DST's global thinking and network provides local concepts in order to comply with the claims for local production of potential end customers.
DST's high-grade products are well-established around the globe. Thus, local industrialisation and service on the spot have formed an integral part of DST's business for decades.
DST qualifies and audits the production plants in country, ensuring the delivery of unsurpassed quality no matter where it has been produced.
DST's expertise is built on great experience, comprising ongoing and successfully accomplished vehicle programmes worldwide. DST has already built up international production plants e.g. in Spain, Greece, Canada and India,
Together with Ray Service, DST is considering the option of building a track production hub in Eastern Europe, with the objective to combine parts from the Czech Republic, Slovakia, Hungary and Germany for integration with one track.
All potential customers like Hungary will additionally take advantage of local production facilities, like for spare parts for or assembly of the other DST tracks for the LEOPARD 2 MBT or the PzH2000 SP howitzer, which are in use in the country.
Looking ahead, DST has already signed co-production agreements in other countries such as the United States and Australia to be well prepared for a timely start of a local production.
Of course, as part of the local production programme, DST also provides a skilled point of contacts on the ground during the entire life cycle of the product.
DST aims to offer a high quality and reliable product with a significant in-country workshare as well as its whole life cycle support by on-site personnel with due consideration of the local business culture.

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Czech IFV Procurement Programme

Martin Smisek

The acquisition of new infantry fighting vehicles for the Army of the Czech Republic reached a key milestone in April 2021 when three shortlisted contenders delivered their technology demonstrators for preliminary testing.

This stage of the selection procedure was set to take place as early as November 2020, but due to the unfavourable situation with the pandemic and safety measures against COVID-19 in the Czech Republic, it could not take place as originally planned. Thus, the technology demonstrators of three manufacturers bidding for the supply of tracked infantry fighting vehicles (IFV) for the Czech Army (AČR),were finally handed over to Czech representatives at Vyškov on 27 April 2021. These are CV90 Mk IV offered by BAE Systems Hägglunds AB from Sweden, LYNX KF41 manufactured by Germany's Rheinmetall Landsysteme GmbH and ASCOD 42 submitted by General Dynamics European Land Systems-Santa Bárbara Sistemas SA from Spain.

Author

Martin Smisek is a Czech freelance journalist specialising in Czech armament programmes and Czech and Slovak military history since WW II.

Preliminary Evaluation

Following the handover, the vehicles have been subjected to rigorous testing performed by more than 200 people including suppliers' representatives and officials from the MoD, AČR, as well as state-owned enterprises Vojenský technický ústav (Military Technical Institute), Vojenský výzkumný ústav (Military Research Institute), and VOP CZ. The main purpose of the tests is to verify the parameters of the respective vehicles, and not to exclude any of the potential candidates.
The aim of the evaluation is to check the selected technical and tactical parameters required by the AČR through 30 different types of testing. As part of this, both the values declared by the manufacturer in the documentation and the practical properties of the vehicles, such as mobility, obstacle crossing and firing capabilities of their weapon systems, will be verified. The results will be then used in the process of assessment and evaluation of individual bids.

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Photos: Czech MoD

LYNX tracked vehicles are suitable for all types of operations – from stabilisation missions to high-intensity combat. They are highly protected, adaptable to different operational scenarios, extremely agile, and have considerable payload reserves.

The actual evaluation has simultaneously taken place at Březina and Libavá military training ranges, the garrison of the 72nd Mechanised Battalion at Přáslavice, Přerov airport, and facilities of Vojenský technický ústav in Vyškov and Slavičín, Vojenský výzkumný ústav in Brno and VOP CZ in Šenov near Nový Jičín. The vehicles have each taken turns at the individual facilities to ensure independent verification of the evaluated parameters. After almost six weeks, the tests will end on 6 June 2021 after which the evaluation of the results will take place over a two-week period.

Among the Czech Army's primary requirements for the new IFV are minimal ballistic protection Level 5 and minimal mine protection Level 4a/4b according to STANAG 4569, modular add-on armour, capability for future installation of soft-kill and hard-kill active protection system, radio-controlled improvised explosive device jammer, and automated collective CBRN protection system. The vehicle has a crew of three with a troop seating capacity of eight persons (standard infantry squad of six soldiers with two specialists on a needs basis, with the other option being two infantry teams with four soldiers each).

The manned turret is equipped with a 30 mm automatic cannon for programmable ammunition, a 7.62 mm coaxial machine gun, and an anti-tank guided missile system. The calibre of 30 mm for the main gun was primarily chosen due to the unification of ammunition with the PANDUR II CZ wheeled infantry fighting vehicles operated by the 4th Rapid Deployment Brigade. However, the turret must be capable of receiving a larger calibre cannon in the future, with relatively minimal changes. Although the minimum elevation range of the main gun is specified from -10° to +45°, the design must allow the upper limit of the elevation to be increased to +60° without the need to change the entire turret.

The sight system for the gunner and commander has to be able to identify a main battle tank at a range of at least 4,000 metres during the day and 3,500 metres at night. The Czech Army demands the vehicle's minimum speed on the road to be at least 65 kph, while the minimum off-road speed should not be lower than 40 kph. Moreover, the specific power output must be higher than 18 kW/t. The

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range of the vehicle has to be at least 500 km.
The communication and information subsystems should comprise a secured VHF/UHF satellite radiostation for voice and data transmission, open architecture diagnostics, a system for combat identification friend or foe, and the Czech BVIS (Bojový vozidlový informační systém) battle management system.
The IFV should have a 30-year service life with at least 10,000 km until to the need for a general overhaul. It must also be air-transportable in a Boeing C-17 GLOBEMASTER III, Ilyushin Il 76MF and Antonov An 124 RUSLAN.

The CV90 Mk IV offered by BAE Systems Hägglunds AB from Sweden is a fifth generation combat-proven Infantry Fighting Vehicle (IFV) which combines improved battlefield speeds and handling with an upgraded electronic architecture to support future growth capabilities.

Delays

In December 2018, it was expected that the contract could be awarded in August 2019 with the actual deliveries underway roughly between 2020 and 2025. However, the schedule proved to be overly optimistic. In the meantime, the requirements of the Czech Army on the new IFV, mainly the manned turret and seating capacity for eight soldiers, were insurmountable for the consortium PSM Projekt System & Management which informed the Ministry of Defence in a letter of 14 October 2019 that it had withdrawn its PUMA from the tender procedure due to the need for a substantial and costly conversion. At the same time, Czech ministerial officials had to rework the original time plan. The revised schedule now expects the signing of the contract by the end of 2020 with the prospect of initial deliveries in 2022.
However, in 2020, a significant delay was caused by the COVID-19 COVID 19 pandemic. This delay brought not only a large number of needless deaths, but also massive financial losses to the state treasury. The repercussions were severe for the IFV acquisition programme as well. The preliminary testing, without which further steps in the tender were not possible, had to be postponed from autumn 2020 to spring 2021. The delay was further aggravated by the difficulties of the Czech state budget.
These negative developments led to the prolongation of planned deliveries of 210 vehicles by two years. Thus, according to the latest timetable, the first new IFVs should be delivered in 2023. Their shipments are then set to continue until 2027. At the same time, the financial plan has also had to be revised. Currently, it

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With different payload capacities and growth potential and its alternative power pack and running gear, The ASCOD 42 manufactured by GDELS offers a wide range of configurations which cover all the major roles of an armoured fighting vehicle.

extends the financing of the acquisition programme to seven years, specifically to the span from 2022 to 2028. The distribution of the payments over a longer period will reduce the burden of installments in the Ministry of Defence budget in respective years.

Immediately after the approval of these changes by the Czech Government on 10 May 2021, the Ministry of Defence sent a request for the submission of a definitive bid to the respective contenders. If everything goes without complications, Prague expects to sign the contract at the turn of the third and fourth quarters of this year. However, this step will probably be taken by the new Government, which will take office after the elections in October 2021. Thus, this development could cause further delays.An integral part of the tender is also a licence for the development, production, modernisation, modification, and authorised service of newly acquired IFVs in the Czech Republic. The involvement of Czech industry in the contract should reach at least 40 % of the acquisition price. A crucial role is played by the state-owned company VOP CZ which serves as the project integrator for Czech industry, as main subcontractor, and future service authority for the vehicles of the AČR. Moreover, the winning bidder is obliged to provide the maximum share of development, production, transfer of technology, know-how, and intellectual property to VOP CZ.

Into the Inventory

The new IFVs are intended for the complete rearming of the 7th Mechanised Brigade and its subordinated units: the 71st, 72nd and 74th Mechanized Battalions, as well as a mechanised company of the 73rd Tank Battalion. Each mechanised battalion will be equipped with 56 vehicles in seven variants (PBVP infantry fighting vehicle, PBV-V command and control vehicle, PBV-PZ reconnaissance vehicle, POV-V recovery vehicle, POV-Ž combat engineer vehicle, POV-DP artillery observer vehicle, and POV-Zdr ambulance vehicle).

The first unit slated for conversion on the new IFV is the 74th Mechanised Battalion which was originally established in October 2008 as a light motorised infantry formation equipped with IVECO LMVs. The unit was reorganised into its current structure on 1 January 2020. However, due to the unavailability of new technology, 15 ancient BVP-2 infantry fighting vehicles had to be pulled from long-term storage at the military warehouse in Rančířov and refurbished into working order. This process started in July 2020 and lasted roughly six months. This interim solution should make it possible to start the retraining of the 74th Mechanised Battalion in the mechanised infantry combat role which will then continue on the newly acquired IFVs. ■

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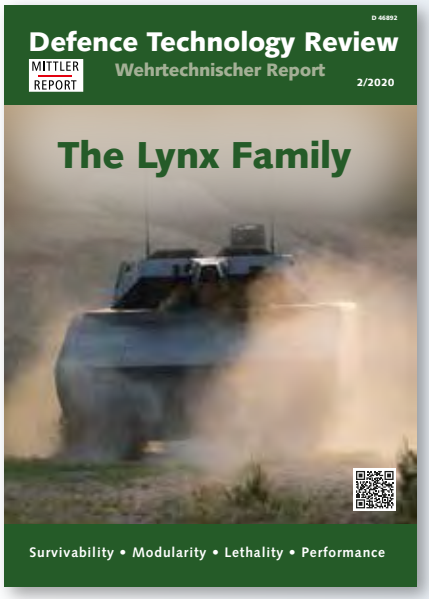

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96 pages

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Japan's Complicated Machine Gun Procurement

Sumitomo Heavy Industries withdraws from ongoing machine gun tender.

Shinichi Kiyotani

Sumitomo Heavy Industries (SHI) had produced a prototype to compete in the tender for the selection of the next 5.56 mm machine gun for the Japan Ground Self-Defense Force (GSDF), but withdrew from the competition in the middle of the procedure.

In 1993, the GSDF selected FN's 5.56 mm MININI (Mk1) to replace the Type 62 7.62 mm machine gun, with Sumitomo Heavy Industries receiving the licence for its production. The new 5.56 mm machine gun is earmarked as its replacement.

A spokesman of the Ministry of Defence (MoD) explained that "SHI withdrew its offer to produce the weapon even if selected," and so the evaluation of SHI's product will not proceed. In response to a question put by ESD, the SHI spokesman said, "We have advised the MoD that we are withdrawing from the competition for the next generation 5.56mm machine guns, and that we will be ceasing all future production of machine guns. However, this does not mean we will be withdrawing from defence-related business entirely."

The original candidates in the tender procedure included FN's MINIMI Mk3, whose contracted agency is Sumisho Aero-Systems, Heckler & Koch's H&K's MG4, whose agency is JALUX, and the 5.56mm machine gun originally developed by SHI.

Photos: via author

Among others, Japan's GSDF has been evaluating FN's MINIMI Mk3 machine gun.

The GSDF has withdrawn the 7.62mm machine gun from service for dismounted infantry. GSDF was previously using the Type 74 7.62mm machine gun, though it was used in coaxial machine guns including on GSDF tanks, armoured fighting vehicles and aircraft door guns for the Japan Maritime Self-Defense Force (MSDF) helicopters. The GDSF spokesman explained that the reason for withdrawing the 7.62mm machine gun from service is that "7.62mm machine guns are not required for the Japanese environment, as the engagement range is short".

The MoD originally budgeted for these machine gun prototypes for trials in FY 2019 and initiated testing in FY2020. The MoD spokesman explained that, "There was a request from SHI to withdraw from the production if it was selected," and therefore the trial was not continued. For this reason, the competition will continue with the remaining two candidates, the MINIMI Mk3 and MG4. The new machine gun is expected to be imported and not produced under licence locally.

SHI has been producing machine guns such as its own Type 74 and undertook licenced production of the 12.7mm M2 machine gun and the 5.56mm MINIMI Mk1.

In 2014, it was found that SHI had falsified data including for the performance and durability of these machine guns and delivered them without meeting the required standards such as the rate of fire and target accuracy set by the MoD over a period of 40 years. As a result, the company was suspended from nominations for a period of five months and fined JPY2.5M.

The unit price of domestically-produced machine guns is about five times that of foreign-made machine guns. The Ministry of Finance often demands an improvement in procurement procedures including the option of switching to imports. In 2016, the MSDF considered switching to foreign-made machine guns due to the high cost of SHI's MINIMI.

To date, the 5.56mm MINIMI Mk1 has been Japan's machine gun of choice.

The GSDF is currently considering successors for the M2 and Type 74, and there is a strong possibility that these will be switched to foreign-made products.

The Japan Steel Works, which produces automatic cannons and guns including tank guns, howitzers for the GSDF, and naval guns for the MSDF, is also interested in the machine gun business, a senior company manager stated. The company recently developed a powered 20 mm cannon for its own Remote Weapon Station (RWS) and proposed this system to the MSDF, but it was not accepted. ■

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Capability Priorities for Dismounted Combat

Manuela Tudosia

In the future operating environment, armed forces will have to be even more rapidly deployable, flexible and scaleable. They should be able to operate independently and be self-supporting in specific locations, but also capable of conducting large-scale operations.

The recent UK Defence Command Paper titled "Defence in a Competitive Age" depicts the future operating environment as "not limited by lines on maps or by geography… confronted by complex and integrated challenges below, and potentially above, the threshold of armed conflict… confronted by state and non-state actors who will employ brinkmanship, malign activity below the threshold of armed conflict, terrorism, proxies, coercion and the deliberate use of economic tools." The Paper highlights an increased role of expeditionary forces and announces the creation of a new Ranger Regiment that "will be the vanguard of this expeditionary posture". Over £120M will be invested in equipping this force in the next four years. Investments will also be made in vehicles relevant for dismounted forces, such as the BOXER.

The publication of Defence White Papers is also expected in other NATO member countries, including Belgium and the Netherlands, but the future operating environment is likely to be quite similar for all NATO and EU countries.

Capability priorities for dismounted combat need to be understood in this context. In the future operating environment, armed forces will have to be even more rapidly deployable, flexible and scalable. They should be able to operate independently and be self-supporting in specific locations, but also capable of conducting large-scale operations. "Units should be able to operate self-reliantly at lower level and to combine with other units (from other branches of the armed forces) and national and international partners. They should be able to operate independently and be multi-functionally deployable. They need to be deployable in a NATO, EU or UN context as well as in ad hoc coalitions or alone." (Dutch Defence Vision 2035).

Photo: NY Army National Guard

US soldiers conduct dismounted training in Fort Drum, NY.

Dismounted forces are no exception when it comes to requirements imposed by the future operating environment. They will have to be even more spread out and autonomous. At the same time, they will have to be better connected and better able to regroup for larger scale combat. They will also have to operate across domains, including the cyber domain, in a battlefield that will be distributed and joint.

At the national level, many NATO nations and NATO partner countries have modernised their dismounted soldier systems during the last two decades. One of the most recent is the Dutch VOSS (Verbeterd Operationeel Soldaat Systeem or Improved Operational Soldier System). However, in the current context, many existing challenges related to dismounted combat become salient and new ones appear, for instance threats in the cyber domain or in the electromagnetic spectrum. Progressively, these challenges are translated into capability priorities that will probably lead to incremental but important improvements of existing soldier systems. It can be assumed that countries whose systems are older (developed during the first decade of the millennium) will have to invest more to adapt to the new operational environment and to integrate new technologies.

As an overarching aspect, more coordination may be needed in the coming years to improve interoperability as well as multi-national cooperation when economies of scale and operational advantages can be better achieved. To date, soldier systems are mostly national though they present many similarities.

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.

In the EU, the Coordinated Annual Review on Defence (CARD) regularly identifies potential cooperation areas that would lead to gradual synchronisation of national defence planning cycles and capability development practices. The 2020 CARD Report recommends 55 collaborative opportunities in capability development, among which six are focus areas. Several of these are directly or indirectly relevant for dismounted combat. Moreover, many of them are expected to be reflected in the 2020 or next year's European Defence Fund (EDF) calls.

One of the six focus areas is to "modernise Soldier Systems as the core of individual force protection and operational effectiveness across all types of operations within the next decade, based on a commonly shared architecture for all related subsystems using cutting edge technology." Related R&T activities highlighted in the CARD Report are artificial intelligence (AI), cyber defence, new sensor technologies, emerging materials and energy efficient propulsion systems, as well as unmanned systems and robotics. All can be relevant to dismounted combat capabilities.

Behind these high-visibility initiatives lie several transversal priorities that need to be constantly considered in any dismounted combat capability project. The ability to respond to these needs is most likely a key differentiator in any competition open to industry to modernise current systems or to develop new ones.

Protection, Lethality and Situational Awareness

These three components must be continuously improved, all the more when dismounted tactical units have to be self-reliant and autonomous for longer. The overarching - and well-known - challenge remains the size, weight and power (SWaP) ratio, let alone the cost. Too much weight can reduce soldier effectiveness, and the complex mix of protection, lethality and situational awareness technologies can cause cognitive burden, leading to progressive degradation of an operator's decision-making abilities. Even before addressing specific technological improvements, capability developers and procurement officers must find the right mix of technologies to assure mission effectiveness and an adequate level of protection. The choice of this mix, including capability integration, can depend on policies, procedures and dismounted combat scenarios envisaged as well as on technological solutions available. Capability developers are moving away from constantly adding new items to the dismounted soldier's equipment to a concept of "soldier as a system". At the same time, system integration is increasingly carried out by the customer while the industry provides the components.

Decision-support tools that present and analyse the complex set of variables to be considered when equipping the soldier would be an understandable need.

Reducing the Load

Reducing the load is unfortunately an almost "eternal" priority. Weight can result from the accumulation of equipment items (the so-called "Christmas Tree" effect) but also from their size or from the materials used.

Better Protection and Lighter Equipment

Less cumbersome equipment, yet performant enough to protect against CBRN, ballistic threats, blast and other shocks will probably remain a constant priority. In addition, adaptation of

SYSTEMATIC SITAWARE

SYSTEMATIC

Photo: via author

A dismounted mission module of a BOXER IFV

Photo: Thales

Soldier systems developed by Thales promise to deliver increased military effectiveness through improvement in tempo, lethality, survivability, sustainability and coordination of operations.

equipment to various climatic conditions to increase thermic comfort without compromising protection or the ability to move are also fields of continuous improvement.

The application of novel materials to protective equipment, is an area with high dual-use potential that could be further explored by industry under the European Defence Fund or future opportunities opened by the recent "EU Commission Action Plan on synergies between civil, defence and space industries". To illustrate the importance of novel materials, at the beginning of the year, the UK Defence and Security Accelerator (DASA) launched a competition that focuses on novel materials, designs and deployment technologies for in-field fortifications that are easily stored, transported and rapidly deployed.

Accelerated by the COVID-19 crisis, there is currently a focus on developing technology that reduces the need for burdensome protective equipment while optimising individual CBRN protection. An example is the DARPA Personalized Protective Biosystem (PPB) program that seeks to improve stability and provide flexibility for field-forward individuals through the application of lightweight materials and adaptable, tissue-protective countermeasures.

The combination of sensing technologies, AI and unmanned systems can enhance human protection by detecting threat and facilitating land manoeuvre. For example, the IED threat is likely to continue in the years to come, and its detection and avoidance with less human exposure is a lasting capability development priority. As smaller unmanned systems become available, this will also have positive consequences on the load.

Soldier augmentation technologies, notably exoskeletons, could also help in the management of load and enhancement of protection. Many improvements must still be made in this area to make them less cumbersome and, when applicable, to find reliable solutions to power them. Armed forces are constantly experimenting and testing exoskeletons, which shows a clear interest.

Lighter Batteries and Better Energy Storage

Sustaining power throughout the mission is essential. In dismounted combat, the need for energy is likely to be exacerbated by the increased use of electronics, like situational awareness sensors, C4I gear and computing units. This need can be met by developing lighter batteries with extended runtimes and/or by reducing the size and power consumption of the soldier-worn technologies. Progressive miniaturisation of soldier- worn items, especially of sensors, is an underlying and constant priority. My recent article on "Miniaturisation – It is not only about technology" in ESD 5/2021 provides an overview of applications where miniaturisation is likely to be prioritised.

Battery runtime is a key variable influencing the weight that must be carried by soldiers before resupply is possible. This affects mission planning and execution parameters. Several portable power solutions have been and continue to be explored to increase energy generation and storage, from advanced but traditional battery technologies to alternative sources like fuel cells, silicon-anode technologies, kinetic energy or even radioisotope powered batteries. Today, fuel cells for use in tactical applications appear to have gained renewed interest and may be considered in future capability development projects. Given the past focus of the EU Commission and the European Defence Agency on energy-related topics, it is highly probable that energy production in operational environments – including the integration of fuel cells – will be among the future EDF calls and projects.

Centralised sources to supply power to individual electronic devices have been increasingly considered in recent years. The centralised systems can be interesting for reducing overall power burden provided that power connectivity is less dependent on too many cables and con-

nectors. This too is an area of continuing development in terms of standards and technology solutions. A mixed power system that combines a central source to power individual devices with the latter's own power sources is probably a necessary compromise as science progresses towards more reliable solutions.

Logistics and Sustainment Loads

Operating independently, being dispersed and self-supporting can have a direct impact on sustainment loads. More food, more ammunition and other sustainment items need to be carried unless the re-supply system is reliable enough. This becomes even more challenging when dismounted operations are taking place in extreme environments, either climatic or location - and risk - related.
Two complementary options are sought to improve this: achieving more independence by reducing weight and increasing power and survivability for longer, and/or improving logistic reliability and responsiveness.
Powering the equipment would mean nothing without the soldier. The human factor, both physiological and cognitive, though less spoken of, is key for mission success. The most basic survivability items are water and food, both heavy but essential. Reducing the weight of water is a very elusive prospect but reducing the food weight by removing water and applying other techniques to increase nutritional density is another field where there is scope for continuing innovation. In the EU, it would most likely be suitable for dual-use related projects.
The United States and other nations are prioritising increasing logistic flexibility and responsiveness, essential for the reliable transport of supplies and of people (for example, MEDEVAC) between the strategic level to the point of need.
Besides development or modernisation of "traditional" assets like helicopters and vehicles, developments in unmanned systems, autonomy or guidance make it possible today to significantly improve logistics in dismounted combat scenarios. The ability to integrate such emerging technologies in both future, but also in legacy armoured platforms, is key from this point of view.

Photo: Rohde & Schwarz

SOVERON HR software defined handheld radio by Rohde & Schwarz provides robust and resilient communications for dismounted soldiers.

Marketing Report: Raytheon ELCAN

Evolving Functionality of Machine Guns for Dismounted Combat

Many NATO forces are looking to upgrade their machine guns because they are mainstays of the infantry squad and main sources of firepower. "The machine gun technology used today is essentially the same as they used in WWII," according to Dan Pettry, a former U.S. Army Ranger and now Product Manager for ELCAN Specter sights. "Machine guns have fallen behind assault rifles in their evolution on the battlefield."
Evolving technologies will incorporate artificial intelligence, networked communications and powered rails into weapon systems but these are longer-term solutions. Near-term, modern militaries need to push existing systems to meet modernization priorities.
Machine guns have traditionally been considered area weapons, used for suppression, unlike rifles which are considered point or precision weapons. Modern militaries are starting to think differently about the most lethal weapon in the squad - machine guns - and demanding precision engagement.
For assault rifles, the ELCAN Specter DR 1-4x dual role sight has pushed qualification ranges out from 300 m to 600 m for infantry soldiers in the ADF (Australian Defence Forces). Now, militaries like the Danish Defence Armed Forces are putting dual role sights on both rifles and machine guns.
Putting more capability onto the machine gun without overburdening the soldier, increases reliability and mission effectiveness. This keeps soldiers safer. The variable magnification and durability of the Specter DR sight gives the soldier an overmatch advantage and significantly increases lethality in dismounted combat.
"The evolving battlefield, especially for the dismounted soldier is changing how militaries think about machine guns," said Pettry. "Mounting a dual role sight enables the machine gun to be a dual role weapon. This solution is ready today."

Photo: Raytheon ELCAN

Photo: USAASC

NETT WARRIOR (NW) is a dismounted situational awareness system used during combat operations, allowing for faster and more accurate decision-making in the tactical fight. With advanced navigation and information-sharing capabilities, leaders are able to avoid fratricide and are more effective and lethal in the execution of their combat missions.

Increasing Lethality and Situational Awareness

With developments in optics, targeting, sensing or augmentation technologies, the possibilities to increase lethality and rapid target acquisition are vast. Reducing weight and size, fusing the data and avoiding information overload remain a constant endeavour though.

A whole range of components, such as electro-optical sensors, lasers, data fusion, advanced power management, have the potential to improve precision targeting. Such incremental improvements are not necessarily visible priorities but exist in the background and often benefit from funding. The development of new weapons tends to focus on a modular design that can integrate external data sources. For example, availability of new technologies like multispectral sensors and smart processing opens the possibility to adjust weapon sight reticles, thereby enabling improved accuracy.

Visual augmentation systems are currently being explored in order to increase soldier lethality, mobility, and situational awareness. Depending on the country, the technology readiness level or market availability varies. For example, after several development and improvement iterations, the US Army Integrated Visual Augmentation System is planned to be fielded at the end of this year. Visual augmentation remains however, an area with significant development potential – and its related challenges, like avoiding latency in the visual display and real-time sensor fusion and data analysis.

An interesting trend is the integration of physiological, biochemical and environmental monitoring sensors to inform about the state of the soldier and his/her surroundings. These can provide relevant medical-related situational awareness, as well as alerts on possible CBRN-related threats. In turn, it could allow better rotation of troops or prevent larger scale CBRN hazards. Probably the trickiest issue is building an appropriate architecture that can transmit, aggregate and analyse the data at the level of higher echelons of command, where the collected information can allow strategic decisions to be made.

Last but not least, the information collected by the myriad of sensors would be useless without communications and good tactical command and control. A GPS-denied environment and other forms of degraded communication or data transmission represent a high risk for dismounted operations. Navigation and movement capacity can also be affected in such circumstances. Investments to find alternative options to GPS and to counter the effects of degraded communication are likely to continue, as well as in cyber defensive and offensive capabilities applicable to dismounted operations.

Photo: Rheinmetall

Rheinmetall`s "Future Infantryman" soldier system is a modular, integrated fighting system designed to provide significant lethality, survivability, mobility, battle command, and training to the infantryman.

Conclusion

Current capability priorities for dismounted combat are the result of old challenges meeting availability of new technologies at an increased pace and a new operating environment, where mission success depends on offensive and defensive actions in several domains (land, air, maritime, but also cyber and space).

With a few exceptions – for example, the EU Generic Open Soldier System Reference Architecture – capability development and procurement for dismounted combat is likely to be characterised by incremental but intensive insertion of new technologies in already existing dismounted soldier system architectures.

Current research trends and capability priorities also show many dual-use applications, opening up opportunities for non-traditional and civilian companies. In this respect, the EU Commission's recent concrete steps to capitalise on dual-use synergies was welcome and long-awaited. ■

SIGINT – Finding the Invisible

IAI's HERON family, represented by the strategic HERON TP, Medium-Altitude Long-Endurance (MALE) HERON 1, HERON MK II and Tactical T-HERON, enables users to employ multi-sensor payloads to support evolving user needs, from the tactical to the strategic levels. Providing commonality across the family, users can now operate mission integrating EO/IR cameras, radars, and SIGINT payloads enabling exciting new operational capabilities. With this multi-sensor surveillance, each UAS of the HERON family uncovers strategic intentions, hidden threats and short-lived targets often missed by conventional means of collection.

Photos: IAI

Today, every military presence emits a distinctive signature that can be picked by visual sensors, radar, and electronic surveillance. The collection activity known as SIGINT – Signals Intelligence – monitors Radio Frequency (RF) signals emitted by systems. Electronic Intelligence (ELINT) monitors emissions related to radars and weapon systems, assessing their mode of activity by analysing signal parameters. COMINT regards intelligence gathered from radios, data links, satellite, and cellular interception. COMINT geolocates each node in symmetric and asymmetric conflicts and predicts even before a conflict, relating activities to known actors, identifying players, and combat formations, enabling analysts to prioritise targets and tracks obtained by other means.

A Game of Cat and Mouse

As threats become sophisticated, so are the sensors that chase those threats. Embracing digital technology, radars and radios use fast frequency hopping, low power, and efficient antennae to maintain Low Probability of Intercept (LPI). Burst digital transmissions of short packets also help evade detection. On the other side, ultra-fast wideband digital receivers can 'hold' even the shortest and weakest signal with these capabilities. Modern SIGINT can scan, detect and track signals of agile emitters such as digital LPI radars and encrypted and frequency hopping software-defined radios, as well as cellular and satellite communications.

With SIGINT sensors becoming more compact, they can be deployed on airborne platforms such as Unmanned Aerial Systems (UAS). Enhanced by powerful data processing capabilities, IAI's modern SIGINT systems produce actionable intelligence in real-time, employing Artificial Intelligence and Machine Learning (AI/ML) to process, filter, and extract the most valuable and meaningful information for the user. To deal with LPI, SIGINT must be able to cover the entire relevant spectrum, and implement robust, advanced processing algorithms to focus on the most important signals.

These capabilities can be deployed on many types of UAS, with EO/IR and radars, on long-endurance missions, performing multi-spectral sensing and multi-modal sensor processing, integrating radar, SIGINT, and EO/IR into a combined picture. Augmented with onboard processing and a wideband data link relaying sensor data to a processing centre, drones operate at the lower altitude, giving users detailed imaging of targets. The SIGINT layer provides the broadest theatre-view, pointing EO/IR and radar to investigate targets, confirm identity, and verify engagement.

Tactical SIGINT Operation

Deploying multiple sensors on small UAS like the Tactical HERON adds new dimensions to tactical operations. These operations may also use COMINT systems to analyse communication activity in the target vicinity. Small tactical UAS carrying such systems can operate as an organic element of the ground forces.

UAS equipped with the common combination of EO/IR and radar cover a narrow footprint, but with SIGINT onboard, UAS broaden instantaneous coverage over hundreds of kilometres per second. Monitoring the battlespace across the RF spectrum, they pick every change that may indicate the appearance of a new threat, even in areas that may seem empty to visual or radar scanning. Geolocating a signal, other sensors onboard UAS probe the area for evidence, which can reveal camouflaged vehicles, people on foot or in moving vehicles, houses, shadowed movement, or hidden underground facilities.

Target-acquisition-based COMINT relies on the analysis of the signal characteristics of specific users/devices like radars or datalinks, emitting unique signals related to specific operational phases and states.

OPVs for and from Europe

Bob Nugent

Offshore Patrol Vessels (OPV) have emerged as a distinct vessel type in response to changing maritime security requirements, such as assuring environmental, economic and national security sovereignty in the Exclusive Economic Zones (EEZs) established by the 1982 UN Convention for the Law of the Sea (UNCLOS).

European ship designers and builders have played a central role in the development of the OPV over the past 40 years. OPV designs from companies in Germany, France, Italy and the Netherlands operate not only in European waters but throughout the world. This article reviews the status of European-origin OPVs now operating, and prospects for new OPVS from and for Europe in the next two decades, drawing on market analysis data furnished by the US firm AMI International.

Definition of OPV

AMI defines Offshore Patrol Vessels as ships capable of operating in and patrolling EEZs for extended periods, measured in weeks and months. By virtue of its mission, an OPV is generally larger than 700 Full Load Displacement tonnes, giving it the needed range and seakeeping characteristics for extended offshore operations. In higher latitudes, north or south, or other regions, larger wave heights drive the need for larger OPVs to operating in those conditions. For example, India operates in waters that are known for very rough conditions. Most Indian OPVs are above 2,000 tons displacement. Nations in South America such as Chile and Argentina with requirements to operate in or near Antarctica also require larger OPVs with reinforced hulls.

An OPV is often built to commercial standards and is slower (top speed less than 20 knots) compared to naval corvette and frigate designs which, in size and displacement, are most similar to OPVs. Some nations have built OPVs with space and weight margins to permit future installation of additional weapons. These OPVs are generally be built to naval standards and meeting naval hull and equipment shock requirements. An OPV is generally lightly armed, with medium sized guns ranging from 40-80 mm. Some OPVs are fitted to carry anti-ship missiles (ASMs) or ASW equipment, such as sonars and torpedoes, in wartime. A good example of this is the Batch 2 of the Royal Navy's River class OPV, with space, rated at 24 kn top speed, and an endurance of 6300nm at 12kn.

Photo: euro-sd.com

FRIESLAND is one of a quartet of Dutch HOLLAND class OPVs built by Damen. The design excels in conducting policing missions.

Author

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OPVs in Service

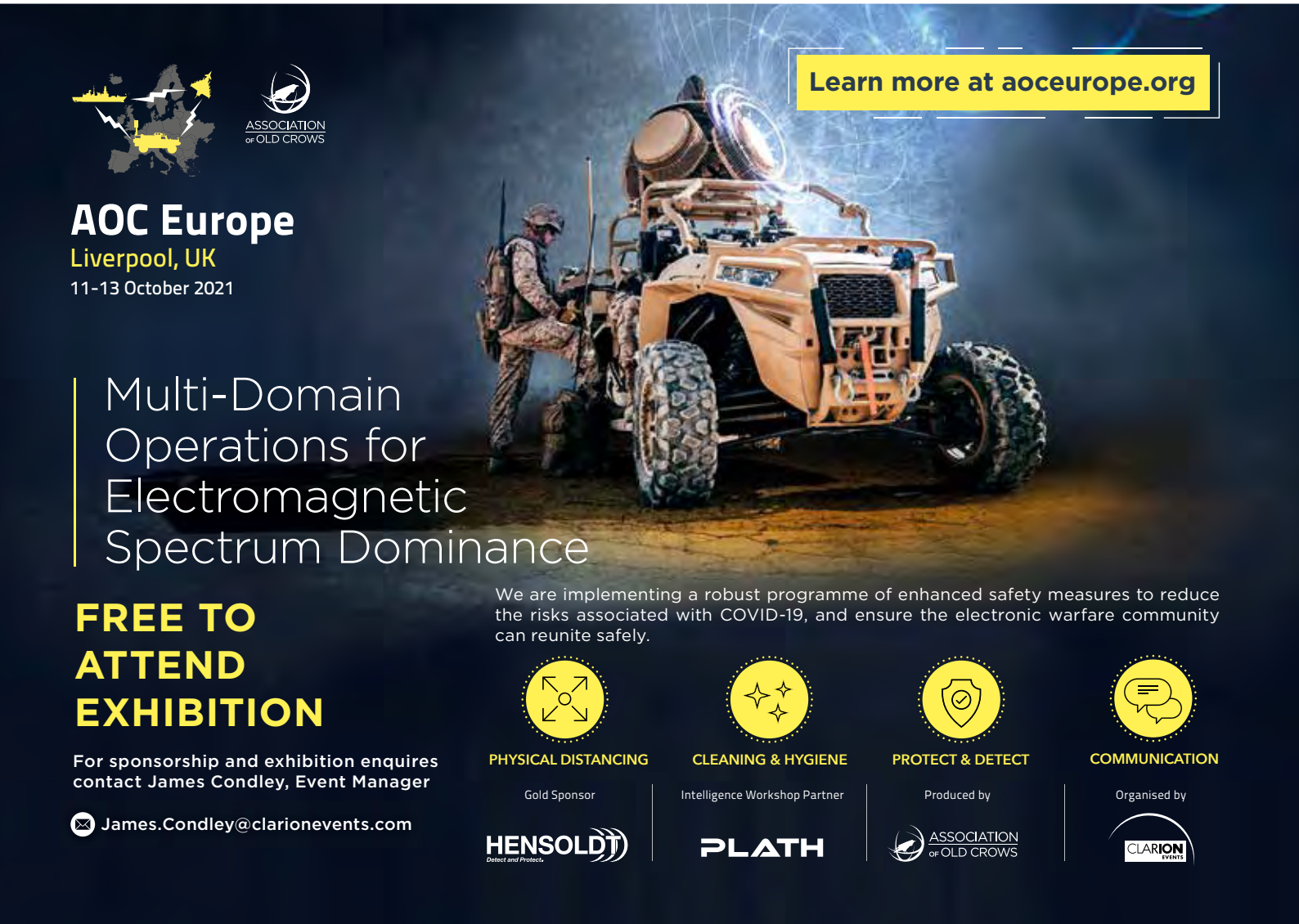
AMI identifies 625 OPVs in service around the world in 2021. Of those, 188 have been built in European shipyards using European designs. This represents about 30% of the total number of OPVs operating today. The table below identifies these 188 hulls by region, age, tonnage and length:

European OPVs are found evenly distributed across regions such as the Caribbean and South America, Sub-Saharan Africa and the Asia-Australia region. Given the size of the latter, one might expect a greater number of European OPVs there. However, strong local construction capabilities in China Japan, South Korea and India account for most OPVs in the Asia-Pacific.

New OPVs	NATO (less US and Canada)	Non-NATO Europe
Average FLD	2878	2500
Average Cost/Hull	130.47	114.37
(US$ Million)		

	Region							
	Asia & Australia	Carib. & L. America	MENA	NATO	Non NATO Europe	Sub Saharan Africa		
Number	15	27	20	92	16	18	188	Total
%	8%	14%	11%	49%	9%	10%	100%	%
Average Age (years)	12.40	22.33	19.25	17.32	18.63	20.67	18.43	Global Average
Avg Displacement	1980.80	1782.11	849.55	1995.76	2528.88	1200.00	1722.85	Global Average
Average Length (F)	247	246	207	264	253	212	238	Global Average

Not unexpectedly, just over half of the world's current fleet of Europe-origin OPVs are found in European countries – NATO and non-NATO nations including Sweden, Finland, Ireland, and Malta. Elsewhere, European OPVs accelerating in the last 20 years. Generally, current OPV fleets are under 20 years old, which is explained in part by two factors. First, is the relatively recent emergence of the OPV as a distinct type, with construction of purpose designed and built OPVs. Second, longer at-sea time in rougher conditions take a particular toll on OPV hulls, requiring timely replacement to ensure enough vessels are ready to meet commitments.



Total Number of projects	In Progress	Planned	Total Value	Total Build 2021 to 2040
65	34	28	40,211.65	266

Photo: Wire Target

Lürssen's OPV 80 has been designed to deploy up to four RHIBs, e.g. in the context of operations against irregular forces.

Within this future market forecast, European acquisitions (NATO excluding Canada and the US) and Non-NATO Europe total 51, or just less than 20%. The table below shows that the average Full Load Displacement of the new OPVs forecasted for Europe through 2021 ranges between 2500 and 2,878 tonnes, while the average acquisition cost per hull for these new OPVs ranges between US$144M and US$130M (2020 US$).

European yards continue to enjoy some OPV export success, although increasing competition from builders in China and Korea have eroded traditionally strong European positions in market such as Algeria and Thailand. Among OPV programmes that are building now in regions beyond Europe, Latin America continues to draw on European builders for design and/or construction. Examples include Argentina, where in November 2018, the Government of Argentina approved the contract to procure four GOWIND class offshore patrol vessels (OPVs) from Naval Group of France. Programmes in Chile and Ecuador (Fassmer) and Uruguay (competition among several European firms) also feature European firms as leaders.

In the MENA region, Libya and Morocco are identified as the best candidates for European suppliers of OPV design and build services. South Africa is also expected to favour European offerors when it reopens the stalled BIRO OPV programme. The Asia-Pacific region remains a growth market for OPVs, but local design and build options, or lower cost alternatives from regional suppliers remain the preference for most countries in the region.

Picture: BAE Systems

The new OPVs of the UK Royal Navy are being built by BAE Systems in Scotland and have been designed for range of 5,000 nautical miles and a top speed of 24 knots.

Future European OPVs

AMI forecasts the market for new OPVs over the next 20 years comprises 266 new hulls to be built, at an estimated total acquisition cost of US$40.2Bn.

Conclusion

The European domestic market remains the core for most European firms engaged in design and construction of OPVs. A comparison of the numbers of current OPVs in service in European nations and the robust new construction programs illustrate that the OPV continues to be a ship type in high demand, and that OPVs will continue to figure prominently in ship procurement plans in Europe.

The situation on the export front is less optimistic. While European firms like France's Naval Group, Damen in the Netherlands and Fassmer and Lurrsen in Germany all offer creative, economical and effective OPV designs, Europe's share of the OPV export market has declined in the face of new competition from local and Asia-Pacific region firms. The continued success of OPVs for and from Europe will increasingly centre on innovative design, operation and logistics support advantages European companies bring to the global OPV market. ■

SOVERON for RIVER Class

Rohde & Schwarz has provided M3SR-Series 4100 HF radios of the SOVERON family for both batches of the British Royal Navy's RIVER class OPVs. The software defined radios (SDR) are designed for shipborne communication and feature a modular design and a high degree of flexibility. Standards-based and proprietary waveforms support secure, voice and data communications in the HF and VHF/UHF frequency ranges. They are installed in racks within a ship's radio room or at a shore station,. They support frequency hopping and provide interoperability with tactical radios in HF operating modes.

Other Rohde & Schwarz reference programmes of the Royal Navy include the two QUEEN ELIZABETH class aircraft carriers, the Royal Fleet Auxiliary's BAY class vessels, and the Type 26 Global Combat Ship.

Photo: Crown Copyright

ESD

European Security & Defence

Issue 9/2021

Europe's leading defence and security magazine.

INTELLIGENCE FOR THE INTELLIGENT

DSEI FOCUS

Ad Reservations: 20 August

Ad Copy: 23 August

Publication Date: 3 September

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THE UNITED KINGDOM

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Unmanned Surface and Underwater Vessels

European Developments

Sidney E. Dean

Unmanned Surface Vehicles (USV) and Unmanned Underwater Vehicles (UUV) are a rapidly growing new element in the world's navies. Mine Countermeasures (MCM) currently constitute a major focal point for unmanned systems but many additional applications are envisioned.

Additional applications include: reconnaissance and surveillance, maritime patrol, port and offshore facility security, escort for high-value vessels, light strike missions, anti-submarine warfare (ASW), and hydrography. Depending on the size of the vessel, payload capacity and power plant, mission duration and range can vary from short to long. By permitting one mothership or operator-crew to control multiple platforms, USVs and UUVs can significantly expand the surveillance or patrol area with comparatively modest investment in resources.

The United States Navy and its US sister services maintain the largest unmanned technology programmes in NATO. However, European nations are also pursuing ambitious USV and UUV programmes, with numerous firms on the continent and in the UK developing innovative technologies. These projects are pursued as national or cooperative programmes, and benefit both NATO and the EU's defence capabilities.

Photo: Kongsberg

HUGIN UUVs have a 15-metre turning radius.

NATO`s Posture on Maritime Unmanned Systems

The July 2018 NATO Summit in Brussels saw the alliance affirm the importance of investment in new unmanned capabilities, including for the maritime domain. Seventeen nations (including the USA, Canada and Australia) have become signatories to the Maritime Unmanned Systems (MUS) Declaration of Intent (DoI) first presented in October 2018. NATO's annual Recognized Environmental Picture, Maritime Unmanned Systems (REM MUS) exercise series was introduced in 2019 to help implement the agreed upon cooperation. Hosted by Portugal, REM MUS is currently the world's largest military exercise solely dedicated to integrating unmanned systems into naval operations. Various general fleet exercises now regularly incorporate unmanned maritime technology alongside manned units. The Unmanned Warrior segment of the British-hosted Joint Warrior 2016 exercise regularly includes dozens of remote controlled and autonomous systems.

OCEAN2020

The European Union is implementing similar initiatives as part of the EU's Common Security and Defence Policy. The OCEAN2020 (Open Cooperation for European mAritime awareNess) programme unites 43 research and industry partners from 15 nations in developing, testing and integrating unmanned systems for maritime operations. It was launched in 2018 and is implemented under the supervision of the European Defence Agency (EDA). According to the EDA, OCEAN2020's main objective is to demonstrate the improvement of maritime situational awareness through the coordinated use of multiple unmanned systems in the three domains (air, surface, subsurface).

The first of two planned live capabilities demonstrations was conducted in the Gulf of Tarento in 2019, under participation of five manned warships, four UAVs, three USVs and two UUVs. The exercise involved two scenarios, namely interdiction of a threatening vessel, and intercept of a mine-laying vessel in advance of an amphibious landing. Manned-unmanned teaming was a central aspect of the scenarios.

The second live demonstration is scheduled for this coming August, and will be held in the Hanö Bight in southeastern Sweden. Eighteen unmanned systems are to be included. In between, the programme has conducted three increasingly complex simulations. According to a March 2021 press release, the latest simulated trial included swarming tactics by

UAVs, USVs and UUVs, and deployment of missile systems on board unmanned aerial and surface systems tasked with neutralising high speed surface threats, protecting choke points and detecting underwater intrusions.

Incorporating Unmanned Systems

The European interest in USV and UUV technology is dictated by the geographical realities of the region. While unmanned systems are being developed which can autonomously cross thousands of kilometres on the high seas, USVs and UUVs are particularly suited to operations in littoral waters, archipelagos, straits and narrows. Their value as force multipliers in the Black Sea, Mediterranean, and Baltic is obvious, but unmanned (and potentially armed) pickets could also serve well along the GIUK Gap and in the Arctic. Several European armed forces are incorporating the ability to carry, refit and deploy multiple USVs and UUVs into the design of new warship classes. These include the UK's Global Combat Ship frigates, Type 31 frigates, and above all the Type 32 frigates (which seem to be largely intended as motherships for unmanned systems). In November 2020, Jeremy Quin, Minister of State for Defence Procurement, explicitly stated that "it is envisioned that Type 32 will be a platform for autonomous systems, adding to the Navy's capabilities for missions such as anti-submarine warfare and mine countermeasures." The future ASW frigates being developed for the Dutch and Belgian navies are being configured with side-bays for 7-metre USVs (the original frigate design, designated the RMF-22D, had called for 12-metre USVs, but was cancelled due to cost). The multi-mission portal at the bow of Sweden's new SAAB A26 submarine class is intended to accommodate, among other equipment, larger and more capable UUVs.

Among the many potential applications (beyond MCM), anti-submarine warfare stands out as the most impressive. In principle, USVs can be equipped with lightweight ASW torpedoes such as Leonardo's WHITEHEAD BLACK ARROW, which was specifically designed to be launched from UAVs and USVs. Given their small size and shallow draft, these vessels are in turn difficult for submarines to combat. Their deployment on manned warships could thus offer a significant enhancement to ASW capabilities, especially in high-priority submarine corridors such as the GIUK gap.

Photo: Kongsberg

HUGIN UUVs are equipped with acoustic communication links providing real time status monitoring of the vehicle and payload sensors.

Photo: Kongsberg

The HUGIN UUV can be deployed from any ship with up to 5 metres freeboard using a proprietary ramp system.

Photo: Kogsberg

The 10-metre long, 1.2-metre diameter HUGIN ENDURANCE can autonomously perform underwater reconnaissance at depths up to 6,000 metres. The operational range of 1,200 nm is 50 per cent greater than the distance between Scotland and Iceland, and four times the width of the Denmark Strait.

USV Programmes in Europe

ECA's INSPECTOR 125 is currently one of the most advanced European USVs. The aluminium-composite-hulled, high-seas capable vessel can be deployed in either autonomous or remote control mode. The potential mission suite includes ASW, ISR (Intelligence, Surveillance and Reconnaissance), force protection, interception and deterrence operations, and MCM. The 12.5-metre boat can autonomously deploy and recover a variety of smaller unmanned systems including UUVs, as well as towed sonars, in up to Sea State 4 conditions. With an at-sea endurance of 40 hours, the boat can significantly enhance a carrier ship's ISR range, including deployment of ASW sensors.

An unarmed INSPECTOR 125 played a central role in the EDA's 2019 demonstration in the Gulf of Tarento, where it was deployed to intercept, identify and warn off an oncoming high-speed vessel, and later to inspect damage done by a manned frigate's gun. During the same exercise, a 7-metre, closed-deck SEAD 23 was used extensively for ISR. Produced by Spain's SeaDrone, the USV reaches 33 kn and has a 200 nm range at 20 kn. Standard equipment includes a thermic/day light gyrostabilised camera, solid state radar, sounder and five high resolution pilot cameras. SED 23 can drop sensors into the sea. Optional equipment – not employed during the exercise – includes a .50 calibre machine gun mount.

Photo: Royal Navy

The Royal Navy began testing the first crewless variant of the time-proven BAE PACIFIC 24 RHIB in 2020. The unmanned platform can be equipped with an LRAD and a remotely controlled machine gun.

Turkey's ULAQ is one of the most powerful armed USVs developed by a NATO nation. The prototype, produced by ARES Shipyard and Meteksan Defence, began sea trials in February 2021. The composite-hulled boat has a top speed of 35 kn and a range of 215 nm (400 kilometres). The 11-metre boat can be launched from shore or from warships. The prototype is armed with four 70mm infrared-guided CIRIT rockets and two 160mm L-UMTAS anti-tank guides missiles; both weapon types are manufactured by Roketsan and have up to 8,000 metres range. The seakeeping trials will be followed by weapons firing trials. As configured, the ULAQ is intended for infrastructure protection, escort, and asymmetric warfare missions. Future planned mission modules will equip the boat for electronic warfare, ASW, ISR, and search and Rescue.

Optionally-manned Rigid-Hulled Inflatable Boats (RHIB) are another force multiplier for surface ships. The 6-metre SEARIDER USV developed by Greek systems integrator Intracom Defence was widely deployed as a reconnaissance/observer platform during the OCEAN2020 experiment of 2019. According to Intracom, the SEARIDER can be equipped with lethal and non-lethal armament for missions including persistent surveillance of sea lane and littoral waters, as well as intercept and neutralisation missions. The British Royal Navy has more recently been testing the PACIFIC 24 and PACIFIC 950 RHIBs equipped with an add-on remote control module. Developed by BAE Systems and ASV Global, these optionally manned RHIBs feature speeds up to 47 knots, and operational endurance of 10 days or 1,200 nm (at 5 knots). Optional payloads include sensors (electro-optic, radar, meteorological, depth sounders), communications and relay suites, long-range acoustic device (LRAD) hailers, and a .50 calibre machine gun mount. BAE systems cites suitability for ASW, ISR, force and installation protection, maritime interdiction and support for manned boarding operations.

Credit: tkMS

Concept of tkMS' Modifiable Underwater Mothership (MUM)

Credit: Msubs

Msubs Ltd, which has been tasked to develop a 30-metre concept UUV for the Royal Navy, has already designed the 9.5 metre MORAY UUV with 48 hours endurance and 305 metre depth capability.

UUV Programmes in Europe

Unmanned underwater vehicles – whether deployed from manned or unmanned vessels – add an additional spectrum to fleet capabilities. Current applications range from MCM to hydrography to ISR. In the near future, considerably larger systems will add offensive capabilities including minelaying and ASW.

Kongsberg's HUGIN family of torpedo-shaped and sized, fully autonomous UUVs is currently being marketed. Military applications include MCM, ISR, rapid environmental assessment (REA), undersea search and survey, harbour protection and port clearance support, and beachhead reconnaissance ahead of

amphibious operations. The UUV can be launched and recovered via Kongsberg's STINGER ramp system in Sea State 4 conditions. Payload options include high resolution still cameras, very high resolution synthetic aperture sonar (with 5x5 cm resolution) or side-scan sonar, various sensors to map and survey the ocean bottom, and chemical sensors to analyse water composition. Depending on configuration, HUGIN UUVs can operate at depths of 6,000 metres, with an endurance up to 100 hours; on seabed imaging and bathymetry missions, the vessel covers 4.5 square kilometres per hour. The newest addition to the line, HUGIN ENDURANCE, represents a major leap in capabilities. Utilising latest developments in lithium-ion battery technology, it features a 15-day uninterrupted mission endurance and 1,200 nm operational range. At 10 metres length and 1.2 metres diameter, the ENDURANCE is four metres longer than the HUGIN 6000, but still fits inside a standard container.

In June 2020, Thyssenkrupp Marine Systems (tkMS) presented the results of their Modifiable Underwater Mothership (MUM) project initiated in 2017. The length of the reconfigurable vessel could vary from 25-50 metres. Emissions-free fuel cell technology would enable the vessel to operate for up to a year at low speeds, with an operational range of 700 nm and operational depths of 2,000 metres. The autonomous system would be suitable for extreme environments including the Arctic. While ostensibly geared toward commercial applications, the MUM concept has clear potential for military missions as well, from ISR to deployment of mines and torpedoes.

Photo: Royal Navy

The Royal Navy is investing £3M into testing unmanned small surface vessels such as the BAE PACIFIC 24 RHIB.

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Photo: BAE Systems

The autonomous PACIFIC 950 RHIB developed by BAE Systems for the Royal Navy can operate for ten days at patrol speed or cover 300 nm in pursuit mode.

Photo: IDE

The SEARIDER USV by INTRACOM DEFENSE (IDE) was used extensively as an ISR resource during the European Defence Agency's 2019 at sea demonstration of manned-unmanned maritime operations.

Photo: EDA/OCEAN2020

An INSPECTOR 125 USV deployed in 2019 during the EDA's Gulf of Tarento exercise.

Image: ECA

A concept of the INSPECTOR 125 deploying a UUV

According to a tkMS statement in 2020, the technology could be operational within a few years.

The British Royal Navy is directly pursuing a stealthy 30-metre long extra-large UUV which would be somewhat bigger than the US Navy's ORCA XLUUV. In 2020, the RN awarded Msubs Ltd a £1M contract for concept work toward developing a test submarine with a range of 3,000 nm and an endurance of three months. As an interim step, the RN is reviewing the feasibility of converting a manned submersible for unmanned operations. Additional funding will be contingent on results of the preliminary research.

New Skill Sets and Mindsets

Widespread introduction of unmanned and autonomous systems will require development of new skill sets and operational concepts. The UK's approach could set a model for other nations. The RN announced in March that it is joining with other government agencies and private sector firms to form the Apprenticeship Trailblazer Group in Autonomous and Remote Vessel Operations. The working group's goal is development of formal apprenticeship programmes for remote and autonomous operations, both above and below the surface. According to the British MoD, the group will initially identify the basic skills and knowledge an individual will need to safely navigate, control and manage small to medium-sized vessels, and provide operators with suitable certification. As the industry grows, the group will develop more advanced knowledge routes and specialties that will be required for the operation of autonomous vessels in both the military and civilian sectors.

Other nations might take a different approach, but ultimately no fleet introducing a large and varied unmanned component can circumvent the need for adapting operational procedures to account for the unique aspects of the new technology. This goes beyond navigational safety or the mechanics of command and control. USVs and UUVs bring new capabilities of their own, while enhancing capabilities of manned ships. Exploiting these advantages to their full potential will require adjustment of operational tactics. Naval academies and staff colleges are already incorporating unmanned systems into their curricula. Whether their impact will be evolutionary or revolutionary remains to be seen, but autonomous systems will transform naval operations. ■

Viewpoint from India

Photo: Debalina Ghoshal

A Global No-First Use of Nuclear Weapons

Debalina Ghoshal

One of the best ways to strengthen nuclear deterrence is to adopt a global no-first-use (NFU) treaty- forcing all nuclear weapon states (NWS) - Britain, France, China, Russia and the US and nuclear weapon powers like India and Pakistan to sign the treaty. Since a treaty is legally binding, states are bound to its norms and commitments; failure to do so can result in punishment.. Such a treaty also raises the global nuclear threshold, thereby strengthening global nuclear deterrence strategic stability. Establishing nuclear-weapons-free zones (NWFZ) is one way to ensure that those states with nuclear weapons can proceed towards a 'no first use' treaty and that threats from newer nuclear weapon states, especially those belonging to a NWFZ, are diminished.

However, one of the unsuccessful elements of the global Nuclear Non-Proliferation Treaty (NPT) has been the failure to establish a NWFZ in the Middle East. Given the instability in the region, a NWFZ is the only way forward to force prospective nuclear power states in that region to sign a global NFU treaty. This means that states like Iran, Israel (believed to be in possession of nuclear weapons), Turkey and Saudi Arabia need to accept a NWFZ in the region. This is a cumbersome task since nuclear deterrence in the Middle East is not just confined to the region in the narrow sense but also to the wider area, known as the Middle East and North Africa (MENA) region.

While the Treaty of Pelindaba has established a NWFZ on the African continent, Egypt, which became a signatory to the treaty in 1996 at the outset, has yet to ratify the treaty. There is no doubt that Israel's nuclear capability has kept Egypt away from ratifying the Pelindaba Treaty. For Israel, on the other hand, with Egypt not ratifying the treaty, its relevance is greatly reduced. Though other African Arab states with possible nuclear capabilities, Algeria for example, have signed and ratified the treaty, due to its past wars with Egypt, it is imperative for Israel that Cairo ratifies the treaty.

Again, the possible military dimension of Iran's nuclear programme negates any possibility for Israel give up on its own nuclear capabilities. In addition, while Saudi Arabia claims its nuclear programme is meant for peaceful purpose, Riyadh has repeatedly refused to accept the US Gold Standard.

Furthermore, in 2019, Turkey's President Erdogan expressed his concern, stating that "Some countries have missiles with nuclear warheads, not one or two. But (they tell us) we can't have them. This, I cannot accept." He further expressed concerns about Israel possessing such capabilities. Thus, while Israel's nuclear capability reveals a domino theory, namely if one state becomes a nuclear power, others want to follow suit, and that includes Turkey. Ankara's journey towards a nuclear weapons capability may reveal a reverse domino theory in the region with Israel finding it difficult to give up its nuclear capability - as seen in the case with Iran. This reverse domino theory for Israel is not just confined to the MENA region, but also extends to the South Asian periphery. The threat from a 2,750 km range SHAHEEN III ballistic missile developed by Pakistan with the capability of reaching targets in Israel is not eschewed by Tel Aviv. Again, Pakistan's reluctance to join the Fissile Material Cut-off Treaty (FMCT) has been a worrying factor.

Many scholars and policy-makers may also advocate for Israel to join the nuclear Non-Proliferation Treaty (NPT) to ensure that a NWFZ is easily implemented in the Middle East through the NPT. However, with threats to Israel also emanating from Pakistan, Israel would find it difficult to join the NPT as long as Pakistan does not join, with the latter's decision depending on India joining.

As long as a NWFZ is not established in the Middle East, the NWS could find it difficult to adhere to a 'global no-first use' treaty. Bilateral 'no-first use' treaties could exist between states, despite them not having adopted a 'no-first use' doctrine, as seen in the case with China and Russia. China's 'no-first use' doctrine is conditional while Russia gave up its 'no-first use' commitment after the collapse of the Soviet Union, but both countries bilaterally maintain the 'no-first use' doctrine.

However, for states to adopt a global 'no-first use' treaty, making the Middle East a NWFZ is a prerequisite for this to happen. States in this region have not declared any nuclear weapons capability, and there are no written or perceived nuclear doctrines or strategies. This ambiguity in the region is another hindrance in achieving a 'global no-first-use'. Moreover, possession of a nuclear weapons capability in this region raises concerns of proliferation risks not just to state actors, but also non-state actors. NWS and nuclear weapons powers will not be able to avoid these threats and concerns.

The TEJAS Light Combat Aircraft

India's Single Largest Indigenous Defence Order

Suman Sharma

It is not about what equipment you have, it is what you do with it. One is reminded how even before the formation of the State of Israel, Messerschmitts were scrambled by an amorphous primitive air force to prevent a Syrian-Egyptian invasion force which planned an attack before Israel was granted statehood.

India has come a long way from its first ever indigenously developed fighter-bomber – the HF-24 MARUT ("Spirit of the Tempest") in the 1960s, when it realised the importance of having its own indigenous fighter aircraft after a war with Pakistan. The HF-24 MARUT debuted after India's crushing defeat at the hands of China in 1962, followed by another Chinese conflict in 1967. The 1971 Indo-Pak War was the first full-fledged war in which the MARUT participated before being discontinued in the 1980s.

Photos: via author

The HAL TEJAS Mk-1A variant is an indigenously designed, developed and manufactured state-of-the-art modern 4+ generation fighter aircraft.

Self-Reliant India

The single largest defence order ever, valued at US$6.575Bn for the indigenous manufacture under the 'Self-Reliant India' (Atmanirbhar Bharat) programme to date was recently awarded to the Indian Government-owned aircraft manufacturing agency HAL (Hindustan Aeronautics Limited) for 83 LCA (Light Combat Aircraft) TEJAS Mk-1A fighter jets for the IAF (Indian Air Force), thereby injecting impetus to the nation's indigenous fighter aircraft capability. The approved procurement includes 73 LCA TEJAS Mk-1A fighters and 10 LCA TEJAS Mk-1 trainers costing US$6.259Bn, along with the design and development of infrastructure worth US$165M.

Aimed at the indigenous design, development and manufacture of advanced cutting-edge technologies and systems in the defence sector under Atmanirbhar Bharat', the manufacture of LCAs by HAL will provide a further boost to the indigenisation policy by energising the domestic defence industry. About 500 Indian companies, including MSMEs (Medium Small Micro Enterprises) will partner with HAL for this order. The primary private Indian players for this order are L&T (Larsen & Toubro), Dynamatic Technologies, Vem Technologies, and Alpha Tocol Engineering Services.

Prime Minister Narendra Modi stated his vision as, "We dream of a day when India is completely self-reliant in defence production and exports defence equipment worldwide."

Responding to PM Modi's clarion call for 'Self-Reliance' amidst the Covid-19 pandemic, and the India-China stand-off, which has lasted eight months, India, the world's second largest arms importer, according to the SIPRI list, went ahead with its biggest indigenous defence order.

Indigenisation

The need for indigenisation was first felt in 1958 by India's first Prime Minister Jawaharlal Nehru when the IGMDP (Integrated Guided Missiles Development Programme) was conceptualised to develop guided missiles at home, a programme which finally took off in the early 1980s. After fighting five major wars with its immediate neighbours and a never-ending counter insurgency, with Maoist Naxalites on a daily basis, and facing sanctions from the West after the 1998 nuclear tests, India realised the importance of having its own weapons programme.

Baba Kalyani, Chairman of Bharat Forge, Kalyani Group, states, "Before 2000, we were unable to design a single car; all the cars were designed in Japan, Europe or somewhere else. We were just converting."

Considering the border challenges and the need to counter the falling squadron strength, the IAF has already received 14 out of the 36 RAFALE fighters from France under a contract signed in 2016. The IAF is also looking forward to its 114 multi-role fighter deal worth over US$15Bn. A fully-loaded LCA Mk-1A costs approximately one third of the RAFALE, according to experts, but a comparison is

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misplaced as both are in a different class, with the LCA falling in the lightweight category and RAFALE is a heavy fighter.
A former pilot (not wishing to be named), says," Given the military stand-off, it makes a considerable sense to produce indigenous equipment and put more and more of them into the hands of the military, as it creates a surprise element for the enemy, as the indigenous equipment is new to the market. Any internationally procured equipment is well known to the enemy in terms of its capability and thus can give him a strategic advantage. The unknown equipment will not give a reaction time to the enemy to counter giving the vital edge (response time) to our forces."
Retired IAF Air Marshal and a former MIRAGE pilot Anil Chopra says, "83 LCA TEJAS aircraft will start inducting from early 2024. LCA Mk-1A production should be complete by March 2022 so there will be a gap of two years. The second issue is the need to ramp up production to at least 18 aircraft per year to make good on the numbers for the IAF. While AMCA (Advanced Medium Combat Aircraft) and LCA Mk-2 development must be sped up, additional fighters should be brought in from abroad. One choice is to go for additional RAFALEs to save time because the RFP has yet to be issued and the full process will take 5-6 years for induction. We have enough infrastructure for two more squadrons."
To augment the production capacity and ensure the timely supply of the LCA Mk-1A to the IAF, a second production facility (Plant II) was handed over to HAL earlier this year. Former HAL Chairman PV Deshmukh observes, "Earlier, HAL had all the workload, therefore could not undertake deliveries on time bringing the efficiency of HAL into question, but this time the Government has followed the Boeing-Airbus model, by bringing in private-public partnership and dividing the work-share. The fuselage, to be made in three parts, and the wings will be manufactured by the private players and the two HAL assembly lines activated for the order will carry out the coupling of the parts, testing and test-flights, all of which will ensure timely deliveries."

LCA Mk-1A

The LCA Mk-1A variant is an indigenously designed, developed and manufactured state-of-the-art modern 4+ generation fighter aircraft. Equipped with critical operational capabilities including the AESA (Active Electronically Scanned Array) radar, BVR (Beyond Visual Range) missile, EW (Electronic Warfare) suite and AAR (Air to Air Refuelling) capability, it would be a potent platform to meet the operational requirements of the IAF. This is the first "Buy (Indian-Indigenously Designed Developed and Manufactured)" category procurement of combat aircraft with an indigenous content of 50% which promises to progressively reach 60% by the end of the programme, after which about 250 out of 344 systems fitted in the aircraft will be home-made.
The deliveries of all 83 aircraft should be completed in an eight-year timeframe. HAL will hand over the first three aircraft in the third year and 16 aircraft per year for five years.
Infrastructure development by IAF under the project was also given the nod by the Government enabling repairs and servicing at base depots so that the turnaround time will be reduced for mission critical systems, thereby increasing availability of aircraft for operational exploitation. As a result, the IAF will be able to sustain the fleet more efficiently and effectively due to the availability of repair infrastructure at respective bases.
A senior industry source says, "The LCA has good content except its engine which is now the GE 404 as the Kaveri programme did not succeed. There are complexities in building an entire ecosystem as the MoD and Government of India have put all their eggs in HAL's basket all along. MoD/HAL's monopoly in the military aviation market is harmful. HAL has ensured that the private players do not carry out the detailed parts and the wing assembly during the proto platforms."
The industry also has other concerns such as sourcing from the manufacturers of detailed parts by being development partners without commensurate value-transfer to them. Private manufacturers are critical of the fact that the Government has been instrumental in intensifying the monopoly of HAL, which has disallowed an ecosystem to flourish, as in the case of Boeing and Lockheed Martin, both of whom are designers and platform integrators while there are super tier-1s who build the airframe assemblies both major and minor - like the front fuselage, rear fuselage, wings, rudders, avionics integrators, engine, and weapon systems suppliers. Without such an ecosystem of T1, T2, T3 levels who construct different levels of aggregates, it is insurmountable to gain scale and product efficiency while meeting timelines.
The LCA programme which began in 1983, has been fraught with challenges of long production delays, engine issues, time and cost overruns. The fighter obtained its initial operational clearance in 2011 and its final operational clearance in 2019. India's audit watchdog CAG (Comptroller & Auditor General) and the Parliamentary Standing Committee on Defence have both cracked the whip on HAL and DRDO (Defence Research and Development Organisation) for their poor performance which has led to delays. ■

An Indian Airforce TEJAS LCA at the Aero India trade show in 2007

Killing the Lurking Submarine

Doug Richardson

For many decades, the classic antisubmarine weapons were the depth charge and the antisubmarine warfare (ASW) mortar. Although effective in their day, both are now totally obsolete, having last seen combat action in the South Atlantic in 1982.

The ASW rocket launcher was a later development with a longer range that the ASW mortar. Now obsolescent, rocket launchers are still being marketed only by Russia and China.

The deployment in 1943 of what was then classified as the MK 24 mine (a measure intended to disguise its true nature) revolutionised ASW operations. This pioneering weapon was the first lightweight ASW torpedo, and used a combination of electric propulsion and passive acoustic homing. A total of 204 were released against submarine targets, and resulted in the destruction of 37 submarines, and damage to a further 17.

Today's ASW torpedoes can be considered descendants of the MK 24. They can be launched from ships, dropped from fixed-wing aircraft and helicopters, or carried to their target area by an ASW missile.

More than 35 nations currently operate the Aerojet MK 46 torpedo, which has been in service since the late 1960s. The MK 46 is 2.59 m long, 324 mm diameter, weighs 230 kg, and is armed with a 44 kg warhead. Powered by a two-speed reciprocating external combustion engine, and guided by active or passive/active acoustic homing, it has a speed of more than 40 kn, and can operate at depths of up to 370 m. The Mod 5 variant became operational in 1979, but a later Mod 5A and Mod 5A(S) versions improved the shallow-water performance.

By the 1970s, NATO faced the threat posed by fast deep-diving nuclear submarines such as the Russian Project 705 ALFA class. Development of a torpedo optimised for this class of target started in 1974, and the resulting MK 50 (developed by Honeywell and manufactured by Alliant Techsystems) entered service in 1991. Its novel propulsion system uses sulphur hexafluoride and lithium to generate steam to drive a pump-jet propulsion system. This gives a speed of more than 40 kn, a maximum operating depth of 580 m and an operational range of 15 km.

Author

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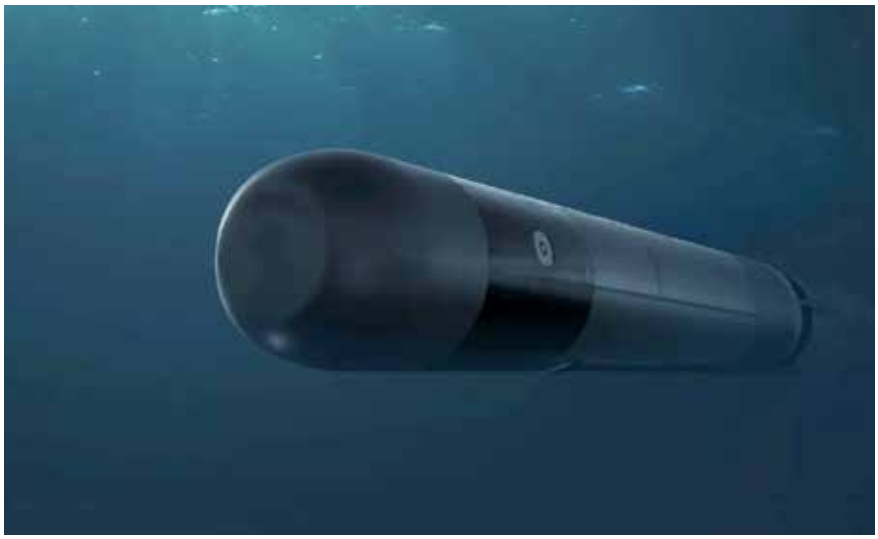
Photo: Saab



The guidance system of the Saab Lightweight Torpedo uses factors such as target speed, size and strength of the acoustic signal to determine whether a target is valid. The torpedo will steer itself to collide with the submarine's hull, and the warhead will be detonated by an impact sensor.

Lightweight ASW Torpedoes

The MK 46 and MK 50 had been designed for deep-water use, but the growing need to conduct ASW operations in littoral waters led to the creation of the Raytheon MK 54 Lightweight Torpedo. This reuses subsystems from other US lightweight torpedoes, including the active or passive/active acoustic homing section of the MK 50 and the warhead and propulsion sections of the MK 46. Designed for release by aircraft or surface ships, and armed with a 44 kg warhead, it has an operational range of 9 km and a maximum speed of more than 40 kn. The MK 54 entered service in 2004. Current users include the US, Australia, India, Netherlands, Thailand, and the UK. Canada and Brazil plan to use conversion kits to upgrade their current Mk 46 torpedoes to the MK 54 standard.

In 1964, the UK launched its own ASW torpedo programme. Development was protracted, but the resulting GEC-Marconi (later Marconi Space and Defence Systems, then Marconi Underwater Systems Ltd then BAE Systems Underwater Systems) STING RAY torpedo entered service in 1982. Propelled by a pump jet driven by an electric motor powered by a magnesium/silver-chloride sea water battery, it had a range of 8 to 11 km, a speed of 45 kn, and a maximum operating depth of 800 m. The improved Mod 1 version was designed to offer an improved shallow-water performance and carries a new shaped-charge warhead. Current users are the UK, Morocco, Norway, Romania, and Thailand. As STING RAY demonstrates, the general pattern in lightweight ASW torpedo development is to base new designs on the size, shape, and other physical specifications of the US weapons. This ensures that the weapon will be compatible with NATO-standard torpedo tubes and airborne carriage and release systems.

France and Italy both planned to develop their own ASW torpedo, starting the Thomson Sintra Murène and Whitehead

A290 programmes in the 1980s. However, the early 1990s saw the formation of the EuroTorp, a Franco/Italian consortium consisting of Whitehead Alenia Sistemi Subacquei (WASS), Naval Group, and Thales Underwater Systems. This organisation became responsible for the A244/S and MU90/IMPACT lightweight torpedoes, the latter resulting from merger of the French and Italian projects.

The MU90/IMPACT is an electrically propelled weapon powered by an aluminium and silver oxide (Al-AgO) sea water battery. It weighs 304 kg, has a maximum speed of 50 kn, a range of over 23 km at minimum speed, and can operate at depths of more than 1,000 m. Current users include France, Italy, Australia, Denmark, Germany, and Poland.

Photo: USN

Sonar technicians on the TICONDEROGA class guided-missile cruiser BUNKER HILL (CG 52) work on a MK 46 torpedo.

The A244S Design

The WASS lightweight torpedo is an older design that entered service in 1982 and has been adopted by around 20 navies. Suitable for launch from surface vessels or from aircraft, it is powered by an electric motor fed by an Al-AgO battery, and is guided by a CIACIO-S seeker able to operate in active, passive or mixed modes. The latest version is the A244-S mod 3.

The A244S torpedo formed the basis for India's Advanced Light Torpedo (TAL) SHYENA. The Naval Science and Technological Laboratory (NSTL) started development of in the 1990s, and user evaluation trials took place in 2003–2005. Electrically propelled, SHYENA has an endurance of six minutes, operating at depths of a few hundred metres. It can perform pre-programmed search patterns, homing onto its target by passive/active homing. SHYENA entered service in 2012, and in March 2021, the Indian Navy successfully conducted the first test-launch from an Ilyushin Il-38 maritime aircraft. Several export orders have been received, but the only identified recipient is Myanmar.

A batch of A244/S torpedoes purchased for evaluation from Italy in 1987, along with a US MK 46 Mod 2 torpedo recovered from the South China Sea in 1978 may have formed the basis for China's Yu-7. Powered by contrarotating propellers driven by Otto fuel II, the Yu-7 entered service in the 1990s. It was followed by the Yu-11. This is longer and heavier than the Yu-7, and is thought to be powered by a pump-jet propulsor.

Like many Japanese weapons systems, the Mitsubishi Heavy Industries Type 97 Torpedo is not exported, but serves only with the Japanese Maritime Self Defense Force. Development was begun in 1989, and the Type 97 entered service in 1997. Powered by closed-cycle turbine running on Otto II propellant, it can be carried by P-3 ASW aircraft and MK 32 torpedo tubes fitted to surface ships.

In South Korea, LIG Nex1 developed the K745 CHUNG SANG EO (BLUE SHARK) torpedo. This can be fitted to surface ships such as the Incheon class frigates, or carried by ASW helicopters and maritime patrol aircraft.

Photo: USN

The USN guided missile destroyer BULKELEY (DDG 84) launches a MK 50 torpedo during an exercise in the Arabian Gulf.

Russian ASW Torpedoes

Current Russian light ASW torpedo is the APR-3E. Designed by Russian Tactical Missiles Corporation JSC to replace the earlier APR-2. It is 3.685 m long, 350 mm in diameter, and weighs 525 kg, so is larger and heavier that its Western counterparts. Suitable for carriage by fixed wing and rotary wing aircraft such as the Tu-142, Il-38, and Ka-28, it travels in an unpowered spiral path after entering the water, while its acoustic seeker searches for targets. Once the target is located, the torpedo ignites its solid-propellant rocket engine and homes at a speed of up to 56 kn. However, its maximum range is only around 3 km. Deliveries of an improved APR-3M version started several years ago.

A new pattern of ship-launched ASW torpedo is entering Russian service. Part of an ASW system designated Paket-E/NK, it is 324 mm in diameter, has a maximum speed of 50 kn, uses acoustic active/passive homing, and carries an 80 kg warhead. In addition to attacking submarines, it can also be used to counter enemy torpedoes, engag-

Photo: USN

An inert MK 54 torpedo is prepared for an OTTO Fuel II spill exercise at the Navy Munitions Command East Asia Division (NMC EAD) Unit at Misawa in Japan.

Photo: UK MoD

Royal Navy Type 23 frigate WESTMINSTER launches a STING RAY torpedo in an exercise intended to test the launcher and the ship's sonar capabilities.

Photo: USN

A RUM-139 VL-ASROC missile is fired from the Mk 41 vertical launching system of the ARLEIGH BURKE class guided-missile destroyer FITZGERALD (DDG 62) during exercise Multisail 17.

ing the latter at ranges of up to 1.4 km. Trials of the system are reported to have ended in 2019.

Designed for the Swedish Navy, the Saab Dynamics Torpedo 47 or SLWT (Saab Lightweight Torpedo) is intended for use against submarine and surface targets. Larger and heavier than most of the torpedoes described so far, it is 2.85 m long, 400 mm in diameter, and weighs around 340 kg. Intended for use from surface vessels, submarines, or aircraft, the design has been optimised for use against littoral submarine targets, as well as surface vessels. Electrically propelled, and powered by a lithium-based rechargeable battery, the SLWT uses guidance via a trailing wire or optical fibre in the early stages of its attack, switching to acoustic homing for the final phase.

ASW Missiles

ASW missiles have a greater range than earlier weapons such as mortars and rocket-launchers, and deliver their payload faster than a shipboard helicopter. Some early types could carry a nuclear depth bomb, but current examples deliver an ASW torpedo. Until the latter enters the water and activates it propulsion system, the submarine being targeted is unlikely to be aware that it is about to be engaged.

Formerly deployed by more than 12 navies, the Honeywell RUR-5 ASROC entered service in the 1960s, but now serves only with Japan and Taiwan. 4.5 m in length, 420 mm in diameter, and weighing 487 kg, it used a rocket motor to deliver a Mark 46 torpedo to a location up to 9.7 km away. After being released from the rocket at a precalculated point on its trajectory, this descended by parachute before entering the sea. A nuclear-armed variant equipped with a W44 10kt nuclear depth bomb was used only by the USN, but was retired in 1989.

Design and development of a vertically-launched version of ASROC that would be compatible with the USN's MK 41 Vertical Launching System missile was begun in 1983 by Goodyear Aerospace (now part of Lockheed Martin). The first version was an RUR-5 ASROC fitted with an upgraded booster section with thrust vector control (TVC) and a digital guidance system. Follow-on RUM-139A and -139B versions retained the Mark 46, but the RUM-139C introduced the MK 54 torpedo. Maximum range is around 22 km. Known operators of ASROC-VL include the US, Japan, and Thailand.

South Korean Designs

South Korea developed its own vertically-launched ASW missile. the LIG Nex1 HONG

SANG EO (RED SHARK) – also known as K-ASROC. The HONG SANG EO is 5.7 m long, weighs 820 kg, has a range of 19 km, and carries the locally developed K745 BLUE SHARK torpedo. It equips South Korea's CHUNGMUGONG YI SUN-SIN (KDX-II) and KING SEJONG THE GREAT (KDX-III) class destroyers.

Chinese and Russian Developments

The CY-1 is China's equivalent to ASROC, but differs from the US weapon in that its rocket-powered booster does not incorporate any form of guidance, but flies a ballistic trajectory until the moment of payload release. It can deliver a ET52 or Yu-7 class torpedo to a range of up to 18 km.

CY-2 is based on C-802 missile, and uses the same turbojet engine. This gives the CY-2 a maximum range of 55 km, but limits the flyout to high subsonic speed. The normal payload is a lightweight torpedo, but a version armed with a depth charge has been reported.

By modifying the CY-2 to carry a Russian APR-3E torpedo, China created the CY-3. A one-way datalink is understood to allow in-flight navigational updates intended to refine the position of torpedo release. A similar development process created an APR-3E-armed version of the CY-1, for which the designation CY-4 has been reported. The introduction of a modular vertical launch system on some modern Chinese warships resulted in the development of the CY-5. Based on the CY-4, this uses a rocket booster fitted with folding control surfaces.

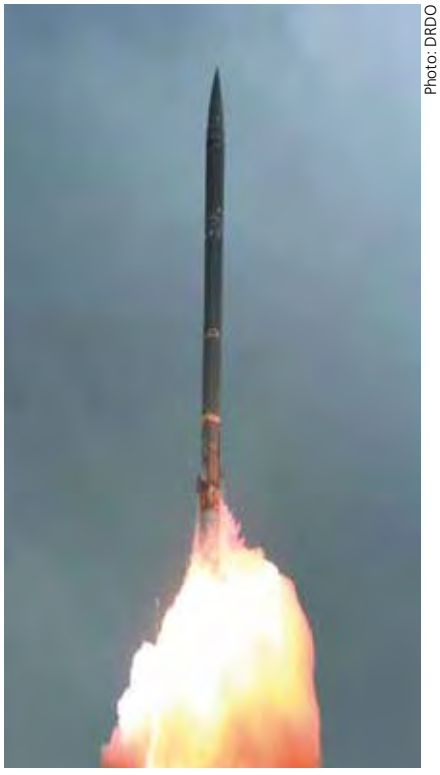


Photo: DRDO

In October 2020, India flight tested its new Supersonic Missile Assisted Release of Torpedo (SMART) missile from a land-based launcher.

Photo: Russian MoD

The box launcher on this Russian UDALOY class destroyer has been opened to show the ship's SS-N-14 missiles.

MBDA's MILAS is an anti-submarine variant of the Otomat Mk2 antiship missile. It started life as a Franco-Italian collaborative programme, but was only adopted by Italy, which uses the weapon on two DURAND DE LA PENNE class destroyers and four BERGAMINI class (FREMM) anti-submarine frigates. MILAS is 6 m long, weighs 800 kg, and carried an MU90 torpedo to a range of more than 35 km in a flight time of less than three minutes, delivering it to a release point that may have been refined via a datalink.

In 2014, Poly Technologies released preliminary details of an ASW variant of China's WS-3 multiple launch rocket system. This was designed to release a lightweight ASW torpedo at a location determined by a suitable "target detection system". At the time, the weapon was stated to be as-yet-untested concept, and there has been no subsequent news of the project.

From 1964 until 1989, the USN fielded the Goodyear Aerospace UUM-44 SUBROC (SUBmarine ROCket). Launched from submarine's torpedo tubes, this 55 km range missile was designed to release a 250 kT nuclear depth bomb. It was to have been followed by the Boeing UUM-125 SEA LANCE, but this 185 km range weapon was cancelled in 1990.

The equivalent Russian weapon is the RPK-2 VYUGA (SS-N-15 STARFISH). Carried by submarines and surface ships, this has a maximum range of 45 km. Two versions are known – the VYUGA-53 of 533 mm diameter designed for use from the Project 705 ALFA class submarines, and the larger VYUGA 65 variant sized to match the 650 mm torpedo tubes.

NATO applied the designation SS-N-16 STALLION to two follow-on designs – the 37 km range RPK-6 VODOPAD of 533 mm diameter, and the 100 km range RPK-7 VETER of 650 mm diameter. These entered service in 1981 and 1984 respectively, and could carry either an ASW torpedo or a nuclear depth bomb.

An older family of Russian ASW missiles is still in limited service on surface ships such as UDALOY-I class destroyers. Known to NATO as the SS-N-14 SILEX, this exists in several variants. These missiles carry an underslung anti-submarine torpedo, or a multi-purpose torpedo suitable for use against submarines and surface ships.

Indian Designs

On 5 October 2020, India's Defence Research and Development Organisation (DRDO) announced that an indigenously-developed ASW missile designated Supersonic Missile Assisted Release of Torpedo' (SMART) had been successfully tested from a land-based launcher at APJ Abdul Kalam Island (earlier known as Wheeler Island) off the Odisha coast. Designed for launch from a warship or a truck-based coastal battery, SMART uses a two-way datalink to communicate with its launcher or to an ASW aircraft, so will be able to receive mid-course flight corrections. Once close the location of the submarine target, it will eject its torpedo payload. Maximum range is expected to be around 650 km. ■

The British Army's EW Posture

Thomas Withington

The UK MOD has promised to buy new electronic warfare systems for the British Army.

The British Government's Defence Command Paper was published in late March. It outlined the UK Ministry of Defence's (MoD's) procurement priorities to support the government's Global Britain in a Competitive Age document. The latter was published just a couple of days before. It discussed the country's foreign policy objectives. The Defence Command Paper gave a glimpse of how the British Army would overhaul its Electronic Warfare (EW) posture.

Almost US$32Bn will be spent on new army equipment and capabilities this decade. The paper said that this includes "new EW and cyberspace capabilities." In excess of US$275M will go towards an "enhanced electronic warfare and signal intelligence capability." This is alongside an increase in Signals Intelligence (SIGINT) personnel. The MoD hopes that deepening the SIGINT cadre and acquiring new capabilities will mean "a significant uplift in (the army's) electronic warfighting capability."

EW is the preserve of the army's 6th (UK) Division; it is tasked with cyber, EW and information operations in peace, war and all in between. The division is a relatively new addition to the army's order-of-battle. Activated in August 2019, it is headquartered at Upavon in southwest England. The 6th Division has a dedicated EW unit, the 14th Signal Regiment, headquartered at St. Athan in southern Wales.

The regiment's mission is to "achieve superiority in the electromagnetic spectrum and deliver intelligence to the Army's land forces." Four squadrons comprise the regiment: the 223, 226, 237 and 245 signal squadrons. 223 Signal Squadron provides EW to UK manoeuvre brigades and is the clearing house for SIGINT gathered by the regiment's other squadrons. 226 Signal Squadron provides airborne and light manoeuvre EW units. It has dismounted SIGINT systems and access to three SC JACKAL wheeled reconnaissance vehicles. This unit chiefly provides EW support to the army's 16th Air Assault Brigade. Armoured manoeuvre EW is the preserve of 237 Signal Squadron. It uses GKN SANKEY FV-439 tracked electronic warfare vehicles and provides EW support to the 12th Amoured Infantry Brigade and 20th Armoured Infantry Brigade. Both are part of the British Army's 3rd Division. Finally, 245 Signal Squadron is a light manoeuvre EW formation. The army says this unit is also developing a tactical cyber warfare capability.

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Photo: GDELSs

The British Army's new AJAX vehicle is a potential platform for the force's new electronic warfare capability.

The mainstay of these unit's capabilities is the L3Harris MEWS SMARTSCAN modular electronic warfare system. Company literature says this covers a two megahertz/MHz to three gigahertz waveband. This permits the detection and location of high frequency and very/ultra-high frequency radios and communications networks. The 14th Signals Regiment also maintains electronic attack weapons to target these radios and networks. This is thought to be based on L3Harris' Broadshield family of electronic attack systems. A dismounted EW capability is provided using the army's Roke Resolve backpack EW systems. Open sources say Resolve covers a 40 MHz to three gigahertz swathe of spectrum. It can be used in both mounted and dismounted configurations.

SOOTHSAYER

The army has had an unhappy history of trying to update its EW equipment. Much of the kit is long in the tooth and needs replacing. Lockheed Martin was contracted by the MoD in 2001 for vehicular and backpack EW systems to gather SIGINT and perform jamming. This acquisition was called SOOTHSAYER. A light vehicular capability was to use SC Group HMT-600 COYOTE high mobility vehicle chassis carrying palletised SOOTHSAYER equipment. A heavy SOOTHSAYER variant was to have used vehicles acquired for the army's now defunct Future Rapid Effects System (FRES) initiative. By 2004, SOOTHSAYER equipment was in production. The MoD had planned an initial operational capability for 2006. SOOTHSAYER was to have cost US$403 million in 2020 values, UK documents noted. However, cost increases of over US$61 million doomed SOOTHSAYER. It was cancelled in 2009.

LANDSEEKER

Project LANDSEEKER attempted to revitalise army EW following SOOTHSAYER's demise. However, an MoD source revealed to the author that it too was discontinued in 2018. The programme

was to have replaced all 14th Signals Regiment EW kit with a single, scaleable EW architecture. It was to gather SIGINT and perform electronic attack. The latter role was to expand considerably. Along with communications, electronic attack would be directed against "non communications targets". This seemed to be a reference to LANDSEEKER attacking radars. This would probably include hostile weapons locating radars, ground-based air surveillance radars and fire control radars deployed on the battlefield by red forces.

A side effect of this electronic attack function would be to attack airborne surveillance radars and fire control radars on red force aircraft. Electronic attack systems have a line-of-sight range. Ground-based equipment is less inhibited when attacking of airborne radars. This is because the curvature of the earth is less of an obstruction when jamming an airborne target. For example, a ground-based electronic attack system with a ten-metre high antenna would have a line-of-sight range of circa 13 km against a hostile ground-based emitter. This same antenna would have a line-of-sight range of over 100 km against an airborne target flying at 2,000 ft.

Photo: UK MoD

The Army's forthcoming BOXER armoured vehicle could be a good fit should the UK procure new EW systems akin to the TLS equipping the US Army.

CEMA

A further factor complicated LANDSEEKER's acquisition. The same year it was to have entered service the MoD published its Joint Doctrine Note 1/18: Cyber and Electromagnetic Activities. This merged EW and cyber activities to embrace a CEMA (Cyber and Electromagnetic Activities) approach where "cyber and electromagnetic activities are interdependent." Both disciplines will complement one another: An electronic attack against a hostile communications network could inject malicious code into red force C2. This could infect these systems with misleading or false information, be used to steal sensitive information or both. Likewise, a cyberattack against a battlefield air defence network could take red force radars offline or substitute targets they are detecting with false traffic.

CEMA is at the heart of the British Army's Electromagnetic Superiority and Supremacy (E2S) posture. The doctrine says that CEMA would work to establish "freedom to use parts of cyberspace and the electromagnetic environment flexibly." Meanwhile it would deny, degrade or constrain "adversary access" to the spectrum to gain "significant competitive advantage." E2S is the sine qua non for success on the battlefields of tomorrow. No army can hope to win the battle, and no nation can hope to win the war without winning the spectrum. E2S depends as much on cyber warfare as it does on EW. Joint Doctrine Note 1/18 shows the MOD is cognisant of this. Words have been followed by actions. On 4 June 2020, the British Army activated its 13th Signal Regiment, headquartered in Blandford in southwest England. This unit will specialise in cyber warfare.

Photo: US Army

The US Army's TLS, a prototype of which is shown here, is one possible answer to the British Army's cyber and EW needs.

Where to Now?

As shown by the 13th Signals Regiment's activation, the army now has a cyber warfare role. However, LANDSEEKER did not seemingly embrace such a capability. Is it feasible to resuscitate LANDSEEKER but add a 'bolt on' cyber warfare tools? Instead, should the MoD favour of a new CEMA architecture? This is the MoD's third attempt to overhaul the army's EW capabilities in two decades. It cannot afford to fail.

Mercury Electronic Warfare said in a written statement that the MoD should think about several factors as it considers the new army EW materiel. Firstly, current systems have a relatively short range. They are sufficient only to intercept emis-

Photo: UK Mod

Light EW to support British Army airborne units is provided by 226 Signal Squadron which uses SC JACKAL vehicles.

sions at line-of-sight ranges of circa 15km (nine miles). This could be alleviated using Uninhabited Aerial Vehicle (UAV) SIGINT collection. The army's Thales WK-450 WATCHKEEPER UAVs would be a suitable platform. In 2017, QinetiQ's AS3 COMINT system was cleared for carriage onboard the aircraft. Whether the AS3 is now routinely used by the WK-450 has not been revealed. Nonetheless, this would provide the over-the-horizon COMINT capability the army needs.

Mercury's statement continues that the army cannot collect electronic intelligence on hostile radars. LANDSEEKER was to have had this attribute. Hopefully, the MoD will retain this requirement for the army's new EW systems. Likewise, LANDSEEKER was to have been capable of electronic attack. The MoD source stated that electronic attack "has been a core offensive activity the army has held in its arsenal for some time." However, this is partially disputed by Mercury's statement which said this capability in its current guise is "weak to non-existent." Nonetheless, electronic attack does seem front and centre of the army's future EW posture: "The ability to disrupt or deny adversarial radio frequency transmissions is a valued and legal targeting activity, with appropriate approvals, which will become of greater utility as militaries become more technology-dependent," the MoD source added.

Finally, dedicated vehicles to accompany the manoeuvre force are essential. Although the SC JACKAL and FV-439 platforms offer some capability, the latter is ageing. Whether the former could adequately support armoured manoeuvre is debatable.

One solution could be to use the original LANDSEEKER requirement as the baseline for the army's new EW capability, Mercury argues. This could have a cyber warfare tools folded in to reflect CEMA doctrine. The new capability could be mounted on new armoured vehicles entering service. One possibility includes a CEMA version of the army's new General Dynamics AJAX armoured infantry fighting vehicles. Another is to use the forthcoming BOXER wheeled Armoured Fighting Vehicles (AFVs).

Options?

The army has three choices: It could purchase a system off-the-shelf from an ally. It could build a system indigenously, or do so collaboratively. The US Army is acquiring the Terrestrial Layered System (TLS). One TLS variant will be mounted on General Dynamics M1133 STRYKER AFVs. The TLS will be deployed with Brigade Combat Teams (BCTs). It will provide electronic and cyber warfare to the manoeuvre force. The army is expected to receive circa 30 vehicles by 2030. The UK enjoys a good defence relationship with the US. Might the MoD be able to procure the TLS for the army? The large number of platforms equipping the BCTs may let the UK benefit from economies of scale.

Alternatively, the MoD could look to European allies. The Armée de Terre (French Army) will need to buy new EW systems to support its manoeuvre force. These will replace legacy EW systems equipping its Renault Véhicule de l'Avant Blindé (Armoured Vanguard Vehicle). This procurement could also take place in the coming decade. Building on earlier defence collaborations, would it not make sense for the UK to collaborate with France on new land force EW systems? This would spread the cost and afford the UK important industrial and scientific participation. The latter would diminish if the TLS was purchased from the United States.

The most expensive option would be to realise the army's requirement indigenously. The Defence Command Paper talks of the army having US$275M for new EW systems. This is significantly below SOOTHSAYER's eventual US$403M price tag. Developing the capability at home would safeguard and develop domestic EW expertise. However, it would do so almost certainly at a cost eclipsing the US$275M available. A bilateral development with an ally could be the best option. Local skills and expertise would be nurtured but the result would be affordable.

The MoD source revealed that the army's future EW capabilities are in the "nascent planning stages and details continue to be worked through." A tentative delivery schedule between 2024 and 2027 is planned, the source added. Legacy systems will be phased out as the new ones are phased in. By 2027, the former are expected to be out of service.

The army faces security challenges like a strategically resurgent Russia modernising her army's battle management, C2 and communications. The British Army needs new EW systems to hold these at risk in any future war. Existing equipment has done good work, but is long in the tooth. Now is the time to make good a commitment already postponed too many times. ■

Body Armour Requirements: Fit for Purpose

Tim Guest

Body armour is an essential piece of equipment for the modern security operative in many of today's militaries, police and security forces. While various body armour requirement standards for police and militaries exist from country to country, the US NIJ standard, often relied on by non-US security and defence forces, is about to see latest major revisions introduced this summer, which will, potentially, be of benefit to body armour users and procurement offices across NATO.

For most militaries, police and security forces around the world, body armour is now a standard item of kit, not only for specialist units, but also for the average soldier and police officer. There are several standards relating to body armour: UK Home Office Scientific Development Branch (HOSDB - 'Home Office Body Armour Standard 2017 provides guidance on the minimum performance requirements and test methods for body armour intended for UK law enforcement agencies'); the US National Institute of Justice (NIJ); European VPAM; and German Police Technische Richtlinie (TR) Ballistische Schutzwesten. However, the HOSDB and the NIJ are the two standards most widely used in the world.

That said, on the eve of its long-awaited revision this summer, setting out much more detailed body armour requirements, it is the new revised NIJ standard - NIJ 0101.07 - on which this article focuses, along with discussion on threat considerations, body armour systems already in service, and certain recent procurements.

Photo: Rheinmetall

For most militaries, police and security forces around the world, body armour is now a standard item of kit. Pictured: The German Army's Gladius soldier system; its body armour protection against bullet, shrapnel and blast injuries can be increased by various protection layers adding up to Class IV protection.

Meeting Stringent Requirements

Body armour is intended to reduce fatalities in military and policing scenarios. That's why materials and systems used in the armour's construct must not only provide protection from ballistic impact, but also must not impede, through weight or design, an operative's ability to carry out a task, more than is absolutely necessary. New materials are constantly evolving in order to keep up with changing operational demands. Weight reduction and improved overall ergonomics are important aspects of that evolution and crucial if a body armour system is to be usable; these factors continue to drive manufacturers to seek out lighter and more efficient materials, so product weight is reduced and users can operate ever more effectively. However, all that comes at a price and system costs will, forever, be a factor for procurement departments. That said, when body armour is used in a particular scenario it absolutely needs to be up to the task in hand; it needs to have been tested to a level that ensures its ability to withstand ballistic impacts from the typical threat expected in the operational scenarios for which it has been procured. Threats faced by police and military forces across the globe do, however, vary and evaluating the suitability of a body armour system for a particular use is complex. For many police, military users and armour manufacturers, testing and evaluation has, for a long time, often been based on the US National Institute of Justice (NIJ) testing standard, NIJ Standard 0101.06, predominantly suited to US police enforcement agencies and the ballistic threats they face. That is not to suggest the NIJ standards are inappropriate for military purposes, for as we all know the kinds of firepower US law enforcement faces on a daily basis is not insubstantial. However, its scope has simply not been wide enough, nor has it addressed many of the weapons encountered in ac-

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Photo: Portland Police, Lesley McLachlan on Unsplash

US NIJ Standard 0101.06 has been predominantly suited to US police enforcement agencies and the ballistic threats they face, though used by many other agencies around the world.

Photo: UK MoD

Hard and soft armour systems need to work for the individual, integrating efficiently with modular, lightweight, load-carrying equipment. VIRTUS, the British Army's latest body armour system is said by the UK MoD to be lighter with a slimmer profile than the previous system and allegedly 'moves with the body more easily'.

tual military operations. That means it really has not been the suitable measure of body armour that some military procurement offices have wanted it, and relied on it, to be. That is, not until now – on the eve of NIJ 0101.07 being introduced.

"What is Your Threat?"

Before looking at NIJ 0101.07 in more detail, expert insights are in order, for which ESD turned to someone very familiar with NIJ Standards and 'all things' body armour, Steve Heaword, Technical Director at specialist equipment maker, Crib Gogh. He said that while many military users have requested a previous NIJ 0101.06 certificate to qualify their body armour, including some European armies, it will have been 'wholly inadequate' for troops operating against threats in places like Afghanistan. He stressed that when testing and certifying a piece of body, the one question that must always be asked is, 'what is your threat?'

"In Afghanistan, the ultimate threat for militaries has been the Dragunov semi-automatic sniper rifle and its various 7.62×54mmR rounds. Body armour operating here needs to be able to stop three rounds at point blank range. However, an NIJ (previous standard) Level 4 plate couldn't achieve that, so it's essential the threat is set appropriately," Heaward said, adding, anecdotally, that some navies, have even allowed the .44 Magnum to be used as part of their threat profile to determine required protection, simply because it was on the previous NIJ spec when their procurement departments filled out the NIJ 0101.06 test form.

"Considering that no pirate or revolutionary guard in a RIB ever tried to board a vessel with a Magnum, this is a little absurd," he said, "for them it's a 9mm, or AK-47. Some users have even considered a Level 3 plate as good enough to stop an AK round, but it's not. An AK mild steel core (MSC) round will go straight through some Level 3 armour plate; as polyethylene development continues to make progress, [Body armour is generally made from a specific kind of polyethylene, called Ultra-High-Molecular-Weight Polyethylene. Ed], a ceramic front would be the better option. The AK-47 is the most widespread threat facing western militaries and its MSC penetrator is nasty. For body armour to resist it, a ceramic front is what's required." It is worth noting here that it is the core of the bullet that controls its penetration behaviour, not the calibre.

Heaward underlined an apparent lack of understanding on the part of many procurement teams as to the operational threats their forces actually face and why it is so important for them to be fully aware of those threats. "The troops on the ground will, effectively, be protecting the sovereign borders of a particular procurement office, whether it is the UK, the US, or another NATO nation. Understanding the operational threats their own troops face is an absolute necessity and applying that knowledge to procuring the right armour is paramount."

The good news is that a new NIJ standard, 'NIJ Standard 0101.07 Ballistic Resistance of Body Armour' is slated for introduction by the middle of this year and draws on the more than ten years of experience under the previous standard.

A Small Taster of a New Standard

For many, it will come as a great relief that NIJ Standard 0101.07 raises the bar, not only regarding test methods for armour, but also its more exacting performance requirements, i.e. the ballistic resistance such equipment must have to protect the torso against both handgun and rifle fire. In addition, threat level revisions have been made to clarify the relevance of the new NIJ standard to 'all' users, including military end users, which is a major leap forward.

The new standard categorises body armour protection requirements into five levels: protection levels NIJ HG1 and NIJ HG2 represent handgun (HG) threats more closely than the Level II and Level IIIA designations previously used in the earlier standard. Also, the soft armour protection, Level IIA threat category relevant to low velocity HG rounds has been removed; what the new standard requires is that conditioned armour panels be shot at, at the very same velocity required of non-conditioned armour, which will help ensure all body armour performs at a high level in any environment and situation. A special set of test requirements have also been introduced specifically for shaped or female body armour.

When it comes to rifle (RF) protection levels, there are many differences and changes. For example, new test rounds and a totally new threat level have been introduced. These new RF1 and RF3 designations have been determined to represent threats much more closely than the previous Levels III and IV, which they replace. In addition, a completely new threat level is RF2, which accounts for an intermediate RF threat and is aimed at protecting against 5.56x45mm NATO SS109/US M855, 62g, lead-core rounds with steel penetrator fired at 3,115 ft/s (950m/s).

In developing the new standard's requirements, the NIJ and collaborators such as the US military, faced two options in their aim to incrementally improve the protection afforded by body armour. They could retain earlier protection levels and reduce weight to provide increased user comfort; or new levels of protection could be introduced with an additional, though minimal, weight increase. For the new standard, it was decided that protection against a wider range of threat ammunition was needed and so the increased-weight option was elected as that best to help underpin NIJ Standard 0101.07.

An extract from the US NIJ on the new standard reads: "Unlike the current and previous versions of the NIJ body armor standard… NIJ Standard 0101.07 will incorporate…a suite of ASTM [formerly American Society for Testing and Materials. ed] standard test methods and practices… Incorporation of relevant ASTM standards…into NIJ standards and US Army requirements and testing documents affords the opportunity to harmonize laboratory test procedures and practices for both law enforcement and military ballistic-resistant armor and other ballistic-resistant equipment, while allowing those end-user communities ultimate control over product specifications, such as the specific threats against which their equipment must protect."

Photo: UK MoD

VIRTUS is due to have a mid-life refresh in the next 18-24 months, which, it is hoped, will make good on some of the end-user issues that have caused concern.

Photo: French MoD

The French FELIN system; version V1.3 for the French Army includes a new load carrying structure plus lighter and more modular armour. On the left-hand combatant's leg, a new, lighter, more modular load-carriage and protection structure improves mobility and reduces the soldier's visual signature.

Photo: French MoD

FELIN's ballistic jacket accommodates flexible ballistic plates, hard ballistic plates and can fit an electronic jacket.

Some Systems, Procurements, Some Thoughts

The UK's previous system, Osprey assault body armour, is still held in store and used in training, but has been replaced by the VIRTUS Scaleable Tactical Vest (STV), which has been designed to increase agility and make it easier to carry heavy kit. Some current, active-service users, however, have expressed their misgivings to ESD as recently as last month about how uncomfort-

able the system is to use, adding to years of already very mixed reviews.

On the official MoD side, VIRTUS is said to use latest materials, offer the same protection as Osprey, though is significantly lighter and has a slimmer profile. First iterations were 4.7 kg lighter than Osprey; latest plate technologies have made the most recent version lighter still. The amount of protection can be scaled up or down to match threats by adding or removing soft armour pads and hard ballistic plates. An integral spine, or 'dynamic weight distribution' system, is linked to the user's waist belt and helps spread the load of the body armour, Bergen or daysack, across the user's back, shoulders and hips. The system also employs a new quick-release mechanism – a pin positioned on the chest that when pulled releases the entire body kit. It also comes in seven different sizes for a tailored fit; chest size and torso length instead of height are now used for measuring.

Industry observers and experts, however, paint a different picture; out of four companies which passed the Invitation to Tender, some with better systems failed because, "European regulations had to be followed".

Photo: French FELIN system, French MoD

Weight reduction and improved overall ergonomics are important aspects of body armour evolution and crucial if a system is to be usable.

In jungle trials, VIRTUS and its predecessor, Osprey, both produced very high thermal burn, though Osprey performed marginally better, although the systems' velcro started to fall apart and fail, showing a lack of suitability for such scenarios. And as no other country in the world has bought VIRTUS beyond the UK, its procurement has not been the success UK MoD has claimed it to be. That said, according to Crib Gogh's Steve Heaward again, VIRTUS is due to have a mid-life refresh in the next 18-24 months. This is hoped to make good on some of the end-user issues that are complained about. The New Plate programme is still under evaluation at this time.

For the French, the FELIN individual soldier combat system includes its body armour system developed by Safran Electronics and Defence, and is said to be one of the more advanced infantry combat systems. Its V1.3 version for the French Army includes a new load carrying structure plus lighter and more modular armour. The ballistic jacket accommodates flexible ballistic plates, hard ballistic plates and can fit an

Source: NIJ

Proposed NIJ handgun (HG) threat levels and associated test ammunition			
NIJ HG Threat Level	**Test Threat Ammunition**	**Manufacturer & Model ID**	**Reference Velocity**
NIJ HG1 (Formerly NIJ 0101.06 Level II)	9mm Luger full metal jacketed (FMJ) round nose (RN) 124 grain	Remington #23558	1305 ft/s (398 m/s)
	.357 Mag jacketed soft point (JSP) 158 grain	Remington #22847	1430 ft/s (436 m/s)
NIJ HG2 (Formerly NIJ 0101.06 Level IIIA)	9mm Luger FMJ RN 124 grain	Remington #23558	1470 ft/s (448 m/s)
	.44 MAG jacketed hollow point (JHP) 240 grain	Speer #4453 or #4736	1430 ft/s (436 m/s)
Proposed NIJ rifle (RF) threat levels and associated test ammunition.			
NIJ RF Threat Level	**Test Threat Ammunition**	**Manufacturer & Model ID**	**Reference Velocity**
NIJ RF1 (Enhanced version of NIJ 0101.06 Level III)	7.62x51mm M80 Ball NATO FMJ steel jacketed spire point boat tail (BT) 149 +0/-3 grain	US military supply or rounds meeting NATO specifications	2780 ft/s (847 m/s)
	7.62x39mm surrogate test round 120.5 grain (7.81 g)	Specifications provided by NIJ	2380 ft/s (725 m/s)
	5.56mm M193 BT 56 +0/-2 grain	US military supply or rounds meeting NATO specifications	3250 ft/s (990 m/s)
NIJ RF2 (Same as NIJ RF1 plus 5.56 mm M855)	7.62x51mm M80 Ball NATO FMJ steel jacketed spire point BT 149 +0/-3 grain	US military supply or rounds meeting NATO specifications	2780 ft/s (847 m/s)
	7.62x39mm surrogate test round 120.5 grain (7.81 g)	Specifications provided by NIJ	2380 ft/s (725 m/s)
	5.56mm M193 BT 56 +0/-2 grain	US military supply or rounds meeting NATO specifications	3250 ft/s (990 m/s)
	5.56mm M855 BT 61.8 ± 1.5 grain	US military supply or rounds meeting NATO specifications	3115 ft/s (950 m/s)
NIJ RF3 (Formerly NIJ 0101.06 Level IV)	30.06 M2 Armor Piercing (AP) FMJ spire point AP 165.7 +0/-7 grain	US military supply or rounds meeting NATO specifications	2880 ft/s (878 m/s)

NIJ nomenclature revisions in the new 07 standard re handgun and rifle threats.

Photo: Honeywell

Body armour technologies are in a constant state of development. Pictured, Honeywell's SpectraShield and GoldShield Body Armour use high-performance composites providing protection against NIJ.06 levels I,II-A, II, III-A, and III threats; the armour is specially designed for comfort and flexibility and is used not only by defence, SF and security agencies in North America, but also by the likes of Australian SF, Royal Netherlands Army, Indian Border Security Force, Israeli MoD, and the Spanish MoD, to name but a few.

Photo: Honeywell

For many police, military users and armour manufacturers, testing and evaluation has often been based on the US NIJ Standard 0101.06. SpectraShield and GoldShield Body Armour, for example, have met this standard's 'effectiveness following water submersion' requirements.

electronic jacket. FELIN also includes bulletproof knee pads. More than 20,000 units of the FELIN system have been delivered to the French military and deployed in mainland France and on overseas operations. The ballistic vest provides a class IV protection on the front with splinter guard protection also provided at points of articulation at the knees, elbows and shoulders.

At the start of last year, just before Covid took hold across Europe, the Estonian Centre for Defence Investment (RKIK) issued a €30M international tender for the procurement and acquisition of ballistic protection in the form of a tactical body armour system. A statement detailed the defence forces were looking for a lightweight three-in-one system comprising ballistic plates that would integrate with bulletproof vest, splinterproof vest, and a tactical vest, with fulfilment slated over the next seven years.

Then, in mid-January of this year, the Minister of Defence for Ukraine, Andrii Taran, announced the country had developed a body armour system requirement in line with NATO standards. He said the MoD of Ukraine had developed its own technical specification for "Modular body armour" as prior to that, the 'armed forces and military formations in Ukraine purchased bulletproof vests on commercial terms'. Taran said the technical specification applies the requirements of state and military standards. Interestingly, and highlighting what has been said above in relation to NIJ standards, Taran said the Ukraine had relied on the earlier NIJ standard in its processes, "In addition, the US Army Standard (NIJ Standard-0101.06) is used to verify the conformity of the bulletproof vest. In addition, the Ministry of Defence has provided all the necessary tests and strict conditions for suppliers. According to this documentation, in 2021, the purchase of bulletproof vests for the needs of the armed forces of Ukraine will be carried out. This is a general military body armour designed for daily combat missions. Its main consumer is the land forces. To perform tasks by special forces or paratroopers in 2021, we will develop a lightweight model." The new 'Modular body armour' is referenced as: TS A01XJ.29423-287: 2020 (01), with the statement adding that it has 'a modular structure and consists of a basic structure, which may have an additional set of protective elements'.

Final Food for Tough, Critical Consideration

Heavily involved in jungle warfare training, Crib Gogh's Steve Heaward is clear about how different body armour systems have performed under such conditions and how such applications are of critical importance as geopolitical tensions rise ever higher in the Far East. He says of recent jungle Warfare trials in Malaysia that all the body armour systems using velcro 'were falling apart and some failed to complete the course at all, including some from US and UK Tier-1 manufacturers. "As soon as algae or dirt build up in the velcro it loses its tenacity. In jungle trials plates were dropping out of systems that used velcro with troops constantly taking them off to readjust them." Though one of the smaller UK manufacturers of body armour – carriage system and armour plate – Crib Gogh's system survived the jungle trials; it doesn't use Velcro, but rather a buckle system.

Two companies which collaborate closely with Crib Gogh are Point Blank, and the UK's Kashket Tactical Group (KTG). The latter, which offers hard armour plate and soft armour plate and has a pedigree spanning hundreds of years, has recently developed a floatation body armour system, and together with Crib Gogh are working on this system for maritime interdiction scenarios. "We are collaborating on a ceramic-fronted plate that floats," Heaward said, "This is a real breakthrough in body armour developments. Kashket's Level 4 plate meets previous NIJ standards, weighs 2.1 kg and with a ceramic front that provides full positive buoyancy enables the wearer to float. Soldiers can actually swim with the plates on and can even jump into a body of water wearing around 10 kg of kit, and resurface without a life preserver. It marks a real operational step change."

Final thoughts stem from Crib Gogh's work with the UK's Royal College of Physicians on 'behind-the-plate trauma reduction', in which the company is at the forefront of research. "How a system dissipates the energy of a projectile strike behind the plate is critical, because the 'energy dump' will still cause trauma problems no matter how good the plate is," Heaward said, "the energy has to go somewhere and the force can still be enough to break a bone, or tear the aorta from the heart, if it hits the plate in the right place."

Sombre words to send a chill down the spine of those relying on body armour for their protection and for which comfort will only be afforded in the knowledge that a wearer's body armour has met the most stringent, up-to-date standards. Procurement departments, please take note. ■

Acknowledgement:
The author expresses his appreciation to jungle warfare expert, Steve Heaword, who is also an advisor to the UK MoD and Technical Director at specialist equipment maker, Crib Gogh, for his insights and input to this article.

Containers for Logistic Support

Christopher F. Foss

As well as revolutionising the transportation of civilian cargo all over the world, containers and their associated load handing systems (LHS) have also revolutionised the handing of supplies for military operations.

This has enabled essential supplies and other material to be rapidly deployed when and where it is needed without any going missing in transit. Once the containers or flatrack have been delivered to their destination, the vehicle can be deployed for other duties. Ammunition and food is typically loaded onto pallets which can then be unloaded from the container by mechanical handing equipment (MHE) such as a fork lift truck. In addition to being used to transport cargo, dedicated containers are also used for a variety of more specialised military applications including use as weapon platforms. They are also used in a modified form for other roles such as command post, communications centre, controlling unmanned aerial vehicles such as the REAPER MQ-9, medical support, messing and workshops to name but a few.
Although sometimes described as a container, many of these are technically shelters with sides than can be extended to provide greater internal volume, with some being shielded against electro-magnetic pulse (EMP) attack and fitted with their own power supply and air conditioning system to allow them to operate in a stand-alone configuration.

Photo: THIELMANN WEW

The German Thielmann WEW HIPPO potable water tank has been built in large numbers for many users including the US Army.

Photo: THIELMANN WEW

Mercedes-Benz Actros fitted protected cab and with mechanical handing unit unloading a Thielmann WEW fuel dispensing unit at the rear and ready for use

Standard Containers

The standard ISO container is 20x8x8 ft., although there are smaller ones, and is typically carried on the rear of an 8x8 or 8x6 platform fitted with a LHS that can rapidly unload and deploy the sealed container where it is required. In addition to transporting containers, the LHS and flatrack is also used to transport a wide range of other specialised military equipment such as bridging boats, folding bridges and specialised engineer equipment. Containers are also used to carry ammunition which can then be loaded into a self-propelled (SP) artillery system.
The Swedish BAE Systems Bofors ARCHER 155 mm (6x6) SP is supported by an 8x8 truck carrying a container of ammunition (projectiles, charges and fuses) which are then loaded into the ARCHERS automatic loader.

Thielmann WEW

There are also contractors which supply more specialised containers for the transport water or fuel, with a good example being the German company of Thielmann

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WEW who since 1998 have supplied more than 3,000 liquid containers to some 13 different governments, with the largest customer being the US Army.
The latest US Army contract was worth US$27.5M and was placed in mid-2018 and covered the supply of 241 HIPPO water containers. Production was rapidly ramped up to one unit a day, with deliveries completed in under a year. This water container has a capacity of 7,700 litres (2,000 US gallons) and is a self-contained drop-and-go drinkable water storage and distribution system fitted within a standard 20 ft. ISO frame and is fully compatible with LHS. It has integrated heating, pumping and diesel engines systems and can pump 125 gallons a minute. Prior to this contract, the company was part of a team that supplied 1,400 liquid containers to the US Army between 2003 and 2013.
Thielmann WEW has also supplied its Deployable Fuel and Distribution Capacity (DFDC) tank container to a number of customers including Belgium Sweden and Luxembourg. This is also integrated into a standard 20 ft. ISO container frame and compatible with standard military LHS including the STANAG 2413 United States (US) Palletised Load System (PLS), and the United Kingdom (UK) Demountable Rack Off-loading and Pick-up System (DROPS), and other forklift and LHS logistic systems. According to the contractor, it can dispense 280/300 litres of fuel per minute at a maximum flow rate via a 3 inch NATO standard coupling. It is fitted with overfill protection and level sensors, a 6 kVA, 400/230 V, 50 Hz electric power generating set and also features integrated transfer pumping and tank self-loading/unloading capability. The two 12 m long dispensing hose reels, each with a nozzle, can dispense lower flow rates of 50 or 120 litres a minute directly into vehicles or containers.

Photo: Iveco Defence Vehicles

The German Army has recently ordered these Iveco Defence Vehicles TRAKKER fitted with a protected cab and LHS to carry a container.

AMPLIROLL and SOFRAME

The French company of Marrel has supplied its AMPLIROLL hook lift system to a number of countries including the French Army based on a Renault Trucks Defense (today Arquus) to meet their requirement for a Vehicule de Transport Logistique (VTL) requirement. Following a competition for the follow-on Porteur Polyvalent Terrestre (PPT) requirement, the French Direction Generale de l'Armament (DGA) awarded the contract to SOFRAME in late 2010 and in the end, three contracts were placed with final deliveries being made in late 2017.
This is based on an Iveco Defence Vehicles ASTRA 8x8 truck with Marrel supplying its AMPLIROLL hook lift system. Iveco Defence Vehicles supplied the 8x8 truck chassis and cab to SOFRAME who fitted the LHS as well as supplying the specialist bodies. The contract covered the Porteur Polyvalent Logistique (PPLOG) fitted with the LHS, trailers and a PPL de Depannage (PPLD) (recovery) vehicle with some of these being fitted with a protected cab with others being fitted with a normal cab or a cab fitted for but not with an applique armour package.

Photo: IDV

An Iveco Defence Vehicles ASTRA 8x8 truck selected by the French DGA for the PPT requirement

The TRAKKER

The German Army uses a variety of trucks fitted with a LHS, with the most recent contract being placed with Iveco Defence Vehicles of Italy covering a frame contract for the supply of up to 1,048 TRAKKER trucks to be delivered from 2021 through to 2028. The first part covers the supply of 224 8x8 from their militarised TRAKKER range which will be supplied in five configurations prepared for 20x8x8 ISO container transport. Some will have hydraulic cranes and winches and have a protected cab. Krauss-Maffei have confirmed that they are to supply the armour-protected cabs for the first batch of 224 TRAKKER with final deliveries in 2024.

The Hiab Multilift

The market leader for LHS is the Swedish company of Hiab (Multilift) who have supplied over 24,000 systems to more

Photo: RMMV

RMMV 8x8 of the British Army carrying a standard 20x8x8 ft ISO container with the truck fitted with protected cab which is also provided with bar/slat amour, electronic devices to counter IED and roof mounted protected weapon station

Photo: MAN Truck & Bus

RMMV HX 8x8 of the British Army upgraded to the latest Enhanced Pallet Loading System Mk 3 configuration carrying a standard 20x8x8 ft ISO container. The forward control cab is fitted with mounting points for applique armour.

Photo: Oshkosh Defense

US Army Oshkosh Palletised Loading System fitted with LHS and towing a trailer with a container after it has been off loaded from a ship

than 33 armed forces all over the world with a typical example being the United Kingdom. The British Army took delivery of over 1,500 Leyland DAF DROPS between 1989 and 1994 and small numbers of these were exported. This is an 8x6 platform fitted with a forward control cab on the rear of which is fitted a Hiab Mark 4 LHS.

The EPLS System

These have already started to be replaced by 382 of the Rheinmetall MAN Military Vehicles (RMMV) HX 8x8 trucks fitted with what the UK calls the Enhanced Pallet Loading System (EPLS) supplied under a £53M contract awarded by the UK Defence Equipment & Support organisation late in 2018. These HX 8x8 trucks are fitted with the standard fully enclosed and air-conditioned forward control cab with provision for an applique armour kit.

These latest upgraded vehicles are designated the EPLS Mk 3 and are replacing the original Leyland DAF 8x6 DROPS Medium Mobility Load Carrier (MMLC) fitted with a Mk 4 handing system with a nominal load of 16.5 tonnes or a 20 ft. ISO container system. Under Urgent Operational Requirement (UOR) funding, 177 HX77 8x8 were upgraded and as well as the applique armour these had bar/slat armour, a roof-mounted protected weapon station, electronic devices to counter improvised explosive devices and a Hiab/Multilift LHS designated EPLS Mk 1 and Mk 2.

The Oshkosh PLS

Following a competition, the US Army selected the Oshkosh (10x10) PLS which consists of the truck, a trailer and the flat racks with production commencing in 1992 with flat racks and trailers being manufactured under licence from SOFRAME of France. In addition to being fitted with the LHS, some are also fitted with a material handling crane between the LHS hook and the power pack while others are fitted with a container handling unit (CHU).

The US Marine Corps (USMC) adopted the Oshkosh MK48 series Logistic Vehicle System (LVS) with the some of the MK14 logistic platform truck subsequently being fitted with a MK18A1 module which has the same PLS as the US Army. This was followed by the Oshkosh Logistic Vehicle System Replacement (LVSR) which some of these fitted with the same LHS as fitted to the earlier LVS. ■

Photo: Suman Sharma

India Fights a Deadly Second COVID-19 Wave

India's Defence Forces Step Up Efforts

Suman Sharma

Aimed at empowering local formation commanders in the fight against the deadly second COVID-19 wave, India's Ministry of Defence (MOD) has invoked special provisions and granted emergency financial powers to its armed forces to speed up their efforts to assist the civilian authorities.

According to official figures, as many as 3,214,706 Indians have lost their lives in the second wave. New Delhi has been offered help from 40 countries. The Indian Armed Forces have mobilised their bases and units, deployed warships to bring home relief material and rendered help to civilians.

Under these special powers, Vice Chiefs of the Armed Forces, including the Chief of Integrated Defence Staff to the CISC (Chairman Chiefs of Staff Committee) and GoC-in-Cs (General Officer Commanding-in-Chiefs) and equivalents of all three services have been given full powers, whereas Corps Commanders and Area Commanders have been delegated powers up to US$68,493 and Division Commanders, Sub Area Commanders and equivalents have been delegated powers up to US$27,397 for expenditure.

Defence Minister Rajnath Singh has reiterated that the civilian population has a great deal of trust in the Indian Armed Forces and looks up to them in times of crisis.

Retired Major General BK Sharma says, "Emergency powers are delegated in case of a dire emergency and have rightly been invoked at the right time. We are in a critical national emergency. In fact, military resources should be employed in creating makeshift hospitals and in rendering other medical aid."

Nearly 600 doctors who retired from the armed forces in the last few years have been recalled to help in the present crisis. The Indian Navy has deployed 200 Battle Field Nursing Assistants across India, while 300 NCC (National Cadet Corps) Cadets have been placed on Covid-related duty.

Maj Gen Sharma adds, "The Government needs to work on a war-footing to overcome its capacity gaps and devise a National Action Plan. To this end, they could utilise the services of veterans, particularly from the medical fraternity."

Cantonment Boards (CB), the civic bodies under the MoD, have come forward to support the civil administration and State Governments. Presently, 39 CBs are maintaining 40 general hospitals with 1,240 beds. Oxygen support has been made available in 37 CBs with a present stock of 658 cylinders. Rapid antigen and RT-PCR tests and vaccination centres have also been set up in most of the Cantonments.

Logistics support provided by the Indian Armed Forces in transporting oxygen containers from abroad, as well as distributing it domestically, has been lauded by the civilian population. Transport aircraft of the IAF (Indian Air Force) have flown 28 sorties from Singapore, Bangkok, Dubai, airlifting 47 oxygen containers with 830 MT capacity, and 158 domestic sorties airlifting 109 containers with 2,271 MT capacity.

As Covid-19 surges, three naval hospitals under the Indian Navy's WNC (Western Naval Command) have been kept ready for use by the civil administration. The Indian Navy has dispatched a 57-member naval medical team comprising four doctors, seven nurses, 26 paramedics and 20 supporting staff to be deployed at the 'PM Cares Covid Hospital', a special hospital set up to manage the crisis.

On the Eastern seaboard, Indian Naval Ship AIRAVAT, has brought home more than 3,600 oxygen cylinders, eight 27-tonne oxygen tanks, 10,000 rapid antigen detection kits, and seven concentrators from Singapore. Ships from the Indian Navy's Kochi-based Southern Command are in the Persian Gulf to bring three liquid oxygen filled cryogenic containers.

On the Western seaboard, Indian Navy ships have set sail to bring home two 27-tonne liquid oxygen tanks from Bahrain and Kuwait.

The Indian Army has set up Covid facilities and placed them on a war footing to provide extensive medical assistance to veterans and their dependents. One such facility has been created at the Base Hospital Delhi Cantonment where the entire hospital has been converted into a Covid hospital with comprehensive arrangements. ICU expansion will ensure 900 oxygenated beds by June 2021.

India's premier defence research agency DRDO (Defence Research and Development Organisation), is setting up five medical oxygen plants in and around Delhi. The medical oxygen plant technology has been developed by DRDO based on the On-Board Oxygen Generation system for the Light Combat Aircraft (LCA), TEJAS fighter jet.

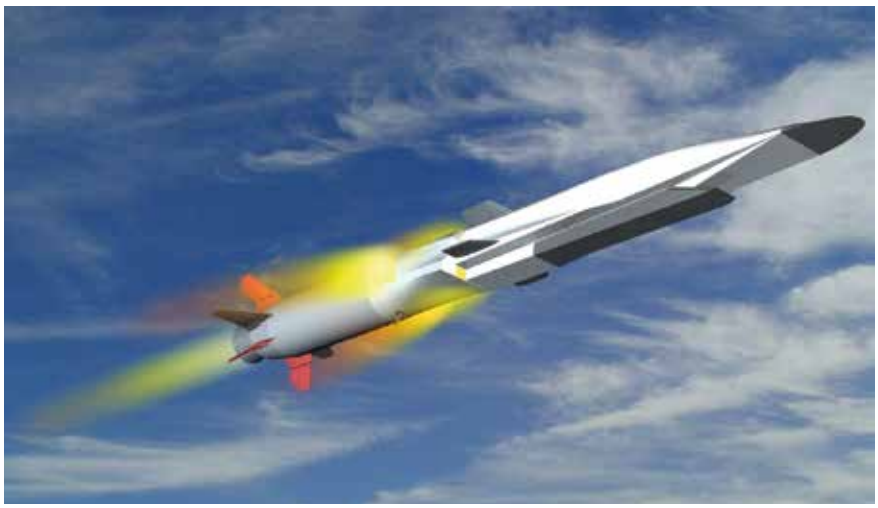
Land-Based Offensive Hypersonic Weapon Programmes

Sidney E. Dean

Speed and manoeuvrability are essential factors determining whether an airborne weapon can evade sophisticated defence systems. Development of agile hypersonic weapon systems has become a priority for technologically advanced armed forces.

ICBM warheads have re-entry speeds exceeding Mach 20, but ballistic weapons fly on predictable paths, facilitating the calculation of an intercept course. Cruise missiles are highly manoeuvrable, but most current systems fly at subsonic or low supersonic speeds, making them vulnerable to standard air defence missiles and to intercept by combat aircraft. Development of agile hypersonic weapon systems has become a priority for technologically advanced armed forces. With flight speeds in excess of Mach 5 and an unpredictable flight path, offensive weapons of this type will be extremely difficult to intercept. For that reason, offensive hypersonic weapons programmes are being augmented by research on hypersonic interceptor systems.

Photo: US Air Force



DARPA's X-51 WAVERIDER hypersonic missile achieved Mach 5.1 flight speed in 2013. The Scramjet (supersonic combustion ramjet) technology being developed could enable hypersonic speed cruise missile flight.

Photo: Raytheon

Concept of the Raytheon-designed scramjet-powered hypersonic cruise missile

Hypersonic Weapon Types

Hypersonic weapons can carry either conventional or nuclear payloads. There are two categories of offensive ground-launched hypersonic weapons: Hypersonic Cruise Missiles (HCM) and Hypersonic Glide Vehicles (HGV).

HCMs differ little from conventional cruise missiles, except that the power plant is capable of sustaining hypersonic speed throughout the duration of the flight. They can be launched from static platforms, vehicles, aircraft or ships.

HGVs, by contrast, are launched as payload aboard ballistic missiles. In this initial configuration, they are referred to as hypersonic boost-glide weapons. Eventually, the actual HGVs separate from the missiles and perform as independent re-entry vehicles. They have no independent propulsion system, but glide toward their target. Unlike traditional ballistic warheads – but like cruise missiles – they are capable of varying altitude in both directions, and executing frequent and sharp turns to evade countermeasures or terrain. Compared to the re-entry vehicles of today's ballistic missile systems, the HGV separates much earlier in the missile's flight, and at a considerably lower altitude; the greater portion of the HGV's independent flight occurs within the atmosphere. As a result, terrestrial radars detect incoming hypersonic weapons much later than they would detect warheads on a ballistic trajectory.

Power Competition

To date, Russia and China enjoy a head start on operational hypersonic weapons. Both nations announced fielding an HGV in 2019. Moscow's AVANGARD hypersonic glide vehicle is deployed as a re-entry vehi-

cle on the SS-19 ICBM, and carries a two-megaton warhead. Official Russian government statements purport a speed of Mach 27. China's HGV is designated the DF-ZF. It is deployed on the DF-17 medium-range ballistic missile, although it remains unclear whether the DF-ZF is fully operational or still being evaluated. Western sources estimate the re-entry vehicle's velocity in the Mach 5-10 range. Both the Russian and the Chinese HGV are expected to be mounted on additional missile models in the future.

The United States and Europe, which only recently re-focussed military research and development to concentrate on great power competition, are playing catch up. While the US, in particular, initiated hypersonic experimentation two decades ago, the running engagements in the Middle East and Afghanistan diverted significant R&D resources to conventional weapons programmes. This prevented exploiting early progress achieved by the Pentagon's Defense Advanced Research Projects Agency (DARPA), which in 2011 managed to fly a technology demonstrator at Mach 20 for three minutes before losing control of the aircraft, which crashed into the Pacific Ocean.

However, agencies on both sides of the Atlantic are now reporting solid progress. The 2019 NATO defence minister summit included hypersonics in its catalogue of seven major emerging and disruptive technologies. While the alliance does not have a centralised hypersonic research programme, Brussels is attempting to coordinate research among its member nations, especially in Europe where economies of scale allow smaller nations and industries to contribute key technologies, but only larger nations have the infrastructure for full-scale programmes. Other nations including Australia, India and Japan are also engaged in hypersonic weapon research. The majority of these programmes, however, relate to either air-launched hypersonic weapons or to hypersonic air and missile defence systems. The most advanced ground-based offensive programme is underway in the US.

Photo: US DoD

In March 2021, the US Army began delivering the first prototype hypersonic equipment to soldiers with the arrival of two training canisters.

Photo: US Navy

Test launch of the LRHW on 19 March 2020

Common Hypersonic Glide Body

The United States Navy and Army are collaborating on the development of offensive hypersonic weapons (the US Air Force was initially also involved, but in 2020 withdrew from this collaborative effort in order to concentrate on a different hypersonic weapon project). Each service is working on a weapon optimised for its own operating environment and tactics, but utilising the Common Hypersonic Glide Body (C-HGB) as a core. This hypersonic glide vehicle will incorporate a conventional warhead, guidance system, cabling and thermal protection shield. The C-HGB is conical, and features small steering fins near the tail. It is painted black to minimise reflection.

Each service is devising its own launchers and operational concepts. The Navy's Office of Strategic Systems Programmes is responsible for C-HGB design, while the Army's Army Rapid Capabilities and Critical Technologies Office is leading the actual production development portion of the programme. This modular approach saves time and money, and allows the three services to exchange technology in a structured environment.

Direct DoD control of the development programme is also necessary because the civilian defence industry, while producing individual components, currently lacks the expertise to manage this unique project. The first set of commercially manufactured C-HGB prototypes is being built by Dynetics Technical Solutions under a 2019 contract. Lockheed Martin has been selected to integrate the glide vehicle, launcher, power system and carrier vehicle into a fully functional mobile weapon system. Other firms involved include General Atomics Electrical Systems (cable, electrical and mechanical manufacturing) and Raytheon (flight control systems).

US Army LRHW

The Army variant of the C-HGB is designated as the Long Range Hypersonic Weapon, or LRHW. Past statements by the Pentagon

cite a range of circa 2,200 kilometres and a potential speed up to Mach 17.
The LRHW will be carried internally in the nose cone of an 88-centimetre diameter, solid propellant, medium-range ballistic missile. The same missile will also be used to carry the Navy's shipboard HGV variant. With the mounted hypersonic glide body, the missile is designated as an All Up Round (AUR). Each AUR will be deployed inside a launch canister. Official US Army photos of prototype launch canisters indicate that the fully configured LRHW will weigh approximately 7,400 kg, not counting the 1,900 kg launch canister.
The launch canisters will be integrated onto ten-metre long M870 40-ton trailers which will be configured as Transporter Erector Launchers (TEL). The TEL will be towed by an Oshkosh M983A4 tractor which is already used for the mobile PATRIOT air defence system. Each TEL will accommodate two missiles. The canisters will be raised to a vertical position before firing. The US Army's standard Advanced Field Artillery Tactical Data System (AFATDS), version 7.0 will serve as the fire control system. A LRHW battery will consist of four TELs, a generator truck, and a command and control vehicle designated as the Battery Operations Center.
The LRHW development is part of the Army's Long Range Precision Fires programme, which also includes development of extended range tube and rocket artillery. While the Pentagon's initial hypersonic weapons research in the early 2000's sought a means to conduct long-range precision strikes against hardened and critical targets within enemy territory, the current programmes focus on attacking targets at shorter and intermediate ranges within the context of a regional conflict. While such weapons could be deployed against any opponent, the operational focus is currently on improving US capabilities in case of war with China. LRHW will contribute to this goal by providing the capability of launching swift strikes over long distances from unpredictable locations. As described in the Army's FY 2020 budget documents, LRHW will "provide the Army with a prototype strategic attack weapon system to defeat A2/AD [Anti-Access/Area Denial] capabilities, suppress adversary Long Range Fires, and engage other high payoff/time sensitive targets."

Photo: US Navy

The 19 March 2020 test launch of the LRHW and subsequent impact in the target zone

Photo: US Army

The Common Hypersonic Glide Body

Testing and Deployment Schedule

Testing of the LRHW's carrier missiles is scheduled to begin this year. A successful test of the C-HGB itself was performed jointly by the Army and Navy on 19 March 2020. The hypersonic glide vehicle was launched from the Pacific Missile Range Facility in Kauai, Hawaii on a surrogate carrier missile. According to then Army Secretary Ryan McCarthy, the C-HGB prototype flew at hypersonic speed and struck the designated impact point with only a 15 centimetre error. Video of the target impact was released in August. It shows a significant energy release, but the Army has not stated whether the prototype was carrying a warhead or whether the target effect was the result of kinetic energy.
The first two LRHW launch canisters were delivered to an undisclosed missile artillery battery on 10 March of this year for evaluation and familiarisation. The canisters are inert, and filled with cement to mimic the precise weight and handling characteristics on a vehicle carrying a full load of missiles. According to an accompanying news release, "all additional ground equipment for the Long Range Hypersonic Weapon (LRHW) prototype battery" will be delivered to the unit later

Photo: Lockheed Martin

Soldiers test the US Army LRHW system in s virtual reality setting prior to fielding.

Photo: General Atomics Electrical Systems

A concept of the US Army's Hypersonic Glide Vehicle re-entry

Credit: Dynetics

The HGV concept

this year. The first live-round testing by the operational battery – including the fully configured AUR – is planned for fiscal year 2022.

Current plans call for fielding the US Army's first complete LRHW battery in 2023. This initial battery will deploy live missile rounds and will have a limited operational capability. It will be assigned to the strategic fires battalion of the Army's Multidomain Operations Task Force. While fully operational, the task force's prime mission is concept and tactics development. The transition of LRHW to a formal acquisition programme of record is scheduled for Fiscal Year (FY) 2024 following successful operational evaluation.

The Bigger Picture

Hypersonic weapons are, of course, not restricted to land-based systems. Aircraft- and ship-launched offensive systems are also being developed and/or introduced by Russia, China and the leading western powers. This includes air-launched hypersonic cruise missiles such as the AGM-183 Air-Launched Rapid Response Weapon (ARRW) which the US Air Force plans to test through FY 2022.

Numerous nations are also pursuing hypersonic missile defence systems as a promising weapon to combat incoming offensive HGVs. In the US, the Missile Defense Agency (MDA) issued in 2020 a draft request for prototype proposals for a Hypersonic Defense Regional Glide Phase Weapons System interceptor, and proposed US$206M to study this technology in FY 2021. DARPA is also pursuing a programme called Glide Breaker, which "will develop critical component technology to support a lightweight vehicle designed for precise engagement of hypersonic threats at very long range." However, the agency's funding request for Glide Breaker was cut by two-thirds for FY 2021, down to only US$3M, implying doubts regarding the current stage of technological maturity. A six-nation European Union consortium is pursuing the TWISTER (Timely Warning and Interception with Space-based TheatER surveillance) programme, which includes space-based surveillance satellites and ground-based hypersonic missiles capable of intercepting incoming HGVs and HCMs. MBDA France is the project's defence industry lead. The system could become operational by 2030.

Photo: DLR

The SHEFEX (Sharp Edge Flight Experiment) test programme conducted by the German Aerospace Center DLR briefly achieved Mach 10-11 flight in 2012 (SHEFEX 2). The programme centres on technologies applicable to hypersonic flight vehicles and spacecraft.

Other development projects have both military and civilian applications. The German Aerospace Centre (Deutsches Zentrum für Luft- und Raumfahrt, DLR) has been conducting the SHEFEX (Sharp Edge Flight Experiment) test programme since 2005, with the primary goal of verifying the potential of a facetted fibre ceramic thermal protection system (TPS) to protect re-entry vehicles – whether hypersonic weapons or space planes – during high-speed re-entry into the atmosphere. DLR partners in this endeavour include the civilian Norwegian Space Agency, which has enabled test flights from the Andøya Rocket Range launch site, and the Brazilian Air Force's Department of Science and Aerospace Technology, which provides the carrier rockets to launch the SHEFEX test vehicles into space.

Some research projects – such as the joint US-Australian HIFiRE and SCIFiRE projects – could eventually lead to the fielding of hypersonic manned or unmanned aircraft as well as cruise missiles; the participating Australian facilities include wind tunnels capable of testing speeds up to Mach 30. While the timing of many projects remains uncertain, there can be no doubt that the Russian, Chinese and US ground-based offensive programmes constitute the beginning of a wave of hypersonic military technology. ■

Upgrading Medium Armoured Fighting Vehicles

Christopher F. Foss

Several countries are now upgrading their fleets of medium armoured fighting vehicles (AFV), tracked and wheeled, to extend their operational lives and, in some cases to give them enhanced capability.

This upgrade can cover the three key areas of armour, mobility and firepower, but in most cases, the upgrade, due to cost constraints, does not always cover all of these elements. In addition to upgrading medium AFVs, there is also a trend to re-role medium AFVs into more specialised battlefield missions with good examples being the BAE Systems BRADLEY M2 series infantry fighting vehicle (IFV) now being re-rolled into the Armoured Multi-Purpose Vehicle (AMPV) which will replace M113 series based vehicles.

Photo: BAE Systems

The US Army BAE Systems BRADLEY M2A4 A1 IFV with twin Raytheon TOW launcher extended on turret side and mounting points on applique side armour for explosive reactive armour

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.

Operational Experience

Operational experience in Afghanistan and Iraq lead to the deployment of large numbers of wheeled Mine Resistance Ambush Protected (MRAP) vehicles for enhanced crew survivability but these do not have the same level of cross country mobility as tracked IFV or 8x8 wheeled AFV. Survivability upgrades can cover increased protection against mines and improvised explosive devices (IED) as well as small arms fire, cannon, rocket propelled grenades (RPG) and anti-tank guided weapons (ATGW). This can take the form of passive add on passive armour, bar/slat type armour packages to neutralise the fuse of the incoming weapon or explosive reactive armour (ERA) to provide a higher level of protection against weapons with a high explosive anti-tank (HEAT) warhead.

Crew Survivability

Crew survivability can further be enhanced by installation of spall liners and crew seats that are not attached to the floor of the platform and are provided with a five-point seat harness.

The platform can also be fitted with electronic devices to counter some types of IED.

For use in high ambient temperatures, an air conditioning system can be installed but the increasing number of other electrically operated systems on the platform can increase power supply requirements so the power supply needs to be upgraded. Additional armour protection enhances the survivability of the platform but does increase weight which can have an effect on the mobility of the AFV as its power-to-weight ratio falls as does its acceleration and top speed. The means that the power pack and suspension has to be upgraded in order to retain mobility.

Latest AFV have an electronic architecture (EA) which makes for easier upgrades as new sub-systems are developed such as communications equipment and battle management systems (BMS).

Firepower

The firepower of the AFV can be increased by the development of new ammunition with enhanced effect or installing a larger calibre weapon, or in some cases a brand new turret with a stabilised larger calibre weapon coupled to a new computerised fire control system (FCS) with day/thermal cameras enabling the platform to engage targets under almost all ambient weather conditions.

Most countries award the upgrade contract to the original equipment supplier (OEM) due to their deep knowledge of the platform. Some countries allow the OEM to work with the government establishments while others have a competition which could be won by a contractor with no previous experience.

Photo: BAE Systems

Head-on view of a BAE Systems Armoured Multi-Purpose Vehicle showing applique armour and protected weapon station but without a weapon installed

MARDER

A good example of a tracked platform being upgraded is the German Rheinmetall MARDER IFV which has been continually been upgraded since the last one rolled off the production line as far back as 1975 through the A1 to A5. The pintle-mounted MBDA MILAN ATGW has been replaced by the locally manufactured EUROSPIKE MELLS ATGW which is also deployed by the German infantry as a replacement for the MILAN ATGW.

In early 2020, Rheinmetall announced that it had been awarded a €110M contract to supply the Germany Army with kits to upgrade 71 MARDER 1A5 between 2020 and 2023. The company will provide the German Army with 78 conversion kits plus vehicle tool kits, special tools, logistical support, initial store of spare parts, training and instruction. The main part will be a new power pack which will boost the engine power from 600 to 750 hp. Other Rheinmetall MARDER 1 upgrades include €24M for 170 driver's night vision devices for delivery between 2021 and 2022, followed by a € 27M contract for 260 new thermal devices for commander and gunner with deliveries running from 2022 through to 2023

Photo: BAE Systems Hagglunds

Latest configuration of the upgraded Royal Netherlands Army CV9035 IFV which has a host of new features including a brand new turret and a hard kill defensive aids system

PUMA

The German Army has taken delivery of 350 PSM PUMA Armoured Infantry Fighting Vehicles (AIFV) of which 342 were IFV and the remaining eight driver training vehicles without the turret. Recently, a follow-on order for an additional 210 has been placed.

The first batch of PUMA are already being upgraded under two steps called PUMA S1 and PUMA S2. PUMA S1 covers command and control, situational awareness and an ATGW capability while S2 is a hunter-killer capability. Externally, the most significant improvement is the installation of a pod of two EUROSPIKE LR2 ATGW on the left side of the turret to engage targets at long range. Currently, the PUMA has a 5.56mm machine gun (MG) but this will be replaced by a 7.62mm MG5.

CV90

The most widely used tracked IFV in Europe is the Swedish BAE Systems Hägglunds CV90, with first of 509 vehicles being delivered to the Swedish Army in late 1993 and final deliveries being made late in 2002. Since then, 262 have gone through an upgrade which included a new BMS and upgrades to the FCS.

Sweden stored 40 CV90 chassis which were originally to be fitted with the AMOS twin 120mm mortar system but in the end were fitted with a Bofors twin 120mm mortar turret, with the complete system being called the MJOLNER (THOR) and with deliveries now complete. Export sales have been made to Denmark, Estonia (surplus Netherlands Army), Finland, Norway, Netherlands and Switzerland, with all of these customers having vehicles modified to meet their own specific requirements. Norway was the first country to carry out a major upgrade of their CV90 vehicles – a mixture of 144 upgraded and new vehicles – which includes 16 multirole vehicles called MULTIC. The latter can be rapidly converted for use as an 81mm mortar carrier, casualty evacuation, cargo carrier or very important person (VIP) transport.

In February 2021, Norway ordered another 20 CV90 combat support vehicles from BAE Systems Hagglunds under a contract worth more than US$50.

More recent upgrade contracts awarded to BAE Systems Hagglunds are those for Switzerland the Netherlands which was announced early in 2021. The Netherlands contract is worth more than

Photo: Rheinmetall

A MARDER 1A5 upgraded with the Eurospike MELLS ATGW, with a missile leaving the pintle-mounted launcher

Foto: Christopher F. Foss

PSM PUMA Armoured Infantry Fighting Vehicle showing a remote turret armed with a 30mm cannon, a coaxial MG and a pod of two Eurospike MELLS on the side

US$500M and covers the mid-life upgrade of 122 CV9035 with an option on an additional 19 vehicles. A new turret will be fitted which according to BAE Systems Hagglunds will provide crews with improved protection and ergonomics. Prior to this contract, work was already underway to provide the CV9035 with an active protection system (APS), ATGW capability and an Electro-Optical Aiming System (EOPS) giving additional situational awareness. The latest upgrade also includes future-proofing the electronics by upgrading to the fourth generation digital backbone with embedded and more robust cybersecurity.

Photo: Lockheed Martin UK

A British Army WARRIOR IFV upgraded under the WARRIOR Capability Sustainment Programme which was cancelled in March 2021

Photo: Rheinmetall

Two German Army upgraded FUCHS 6x6 deployed to Mali and clearly showing the additional armour protection and raised plinth on which is mounted a FLW 200 RWS

WARRIOR

The British Army took delivery of 789 WARRIOR IFV and variants from the then GKN Defence, now Rheinmetall BAE Systems Land (RBSL) at their Telford facility. They have been upgraded on a number of occasions with a new General Dynamics UK BOWMAN communications system, Thales BATTLEGROUP Thermal Imaging (BGTI) replacing earlier image intensification systems and a host of upgrades under Urgent Operational Requirement (UOR) funding.
Following a competition in 2011, Lockheed Martin UK were awarded the contract for the WARRIOR Capability Sustainment Programme (WCSP), although they did not have previous experience in upgrading AFVs. This major upgrade included the WARRIOR Fightability and Lethality Improvement Programme (WFLIP), WARRIOR Enhanced Electronic Architecture) and WARRIOR Modular Protection Systems (WMPS). Trials with prototypes were undergoing Reliability Growth Trials (RGT) with some 80% complete when the whole programme was cancelled in March 2021. In its place, the BOXER (8x8) will be deployed which were originally earmarked for deployment by the Strike Brigades.

Photo: Christopher F. Foss

The Nexter VBCI 8x8 IFV fitted with a Nexter T40 two person turret armed with a 40mm CTAS, a roof-mounted remote weapon station armed with a 7.62mm MG and a pod of ATGW mounted either side

Photo: Rheinmetall

The BOXER 8x8 MRAV fitted with a Rheinmetall LANCE turret armed with a 30mm cannon and a 7.62mm co-axial MG

BRADLEY M2/M3

The US Army took delivery of 6,452 BRADLEY M2/M3 series vehicles but the only export customer was the Kingdom of Saudi Arabia who took delivery of 400 units. The M2 is the IFV and the M3 is the cavalry version, although many of the latter have been converted to M2 standard. Since the last one rolled off of the production line as far back as February 1995, the BRADLEY has been constantly upgraded as new technology has matured and threats have changed, although all armed still armed with the Northrop Grumman 25mm M242 dual feed cannon and 7.62mm co-axial MG. The upgrades include the Bradley M2A1/A2/A3/A4 with many sub-variants with this work normally carried out by BAE Systems in conjunction with the US Army Depot at Red River. In addition to installing applique passive armour, the M2 BRADLEY has also been fitted with ERA, new sighting systems, upgraded power pack and suspension to name a few. The US Army still deploys large numbers of M113's series vehicles for a wide range of battlefield missions such as ambulance, command port and mortar carrier. These were designed over 60 years ago and although upgraded no longer, they have the mobility and protection to operate with the upgraded M2 series BRADLEY. With the downsizing of the US Army, large numbers of M2/M3 series BRADLEY are now surplus to requirements and these are being re-rolled into the AMPV. The original intention was to use the existing hull but new aluminium hulls have been fabricated and five versions to be deployed, with these being Mortar Carrier Vehicle, Mission Command Vehicle ,Medical Evacuation Vehicle, Medical Treatment Vehicle And General Purpose. Following trials with 29 prototype AMPVs in early 2019, the US Army awarded BAE Systems a US$128M contract for Low Rate Initial Production (LRIP), followed a second contract worth US$447M in February 2019 and which was follow by two contract modifications worth up to US$575M for the vehicle. On 31 August 2020, BAE Systems delivered the first AMPV to the US Army, which will be deployed by the Armored Brigade Combat Teams (ABCT). A key feature of the AMPV is that it has built in growth potential to add new capabilities as technology evolves including enhanced power generation for advanced electronics and network connectivity.

Upgrading Wheeled AFV

As well as upgrading their tracked IFV, some countries are also upgrading at least part of their fleets of wheeled AFV. The French Army, for example, has upgraded part of its fleet of Nexter VBCI to allow them to be fitted with additional armour. For the export market Nexter are offering the VBCI with different weapon systems as the French Army vehicles have a one person turret armed with a 25mm cannon and 7.62mm co-axial MG.
The VBCI has been shown in Europe and the Middle East fitted with a Nexter T40 two-person turret armed with a 40mm CTAS, a roof-mounted RWS armed with a 7.62mm MG and a pod of ATGW either side. The German Army took delivery of almost 1,000 now Rheinmetall FUCHS (FOX), with final deliveries taking place from the Kassel production line as far back as 1986. Since then, the vehicles has been constantly upgraded as well as being adopted for new missions. The latest FUCHS A8 has been upgraded in a number of key areas including enhanced protection against mines and IED and have a gross vehicle weight of 24 tonnes.
The ARTEC BPOXER (8x8) MRAV is entering service with an increasing number of countries. For deployment to Afghanistan, an upgrade to the German Army BOXER A1 configuration started which included desert camouflage, enhanced protection against mines and IED, electronic countermeasures and a raised plinth on which the Krauss-Maffei Wegmann FL 200 remote weapon station (RWS) is fitted allowing for greater depression of the 12.7mm MG of 40mm automatic grenade launcher to engage close in targets. For the export market Boxer is offered with a number of weapon systems, with Australia opting for the Rheinmetall LANCE turret armed with a 30mm cannon and a 7.62mm co-axial MG. ■

CBRN Respiratory Protection and Filters

Dan Kaszeta

Many CBRN threats, like phosgene gas, which was responsible for the majority of chemical warfare fatalities in the First World War, are really only serious threats through the human respiratory system. As such, filtration of air for breathing is an important component of CBRN protection and is a key area of technology in both military and civil protection contexts.

The majority of lethal scenarios and situations in CBRN warfare or terrorism involve threats that are inhaled. Inhalation of gas, particles, vapour, or aerosols pose more lethality than liquids absorbed through the skin. Since the advent of chemical warfare in 1915 in the First World War, the primary defensive countermeasure against attacks with chemical agents has been the so-called "respirator", "gas mask", or "protective mask". Terminology varies from country to country for the same identical item of equipment. These terms are used interchangeably in this article.

It should also be noted that the CBRN protection market overlaps with but by no means is the same as the civilian respiratory personal protective equipment (PPE) market. Some of the industrial players, described below, play in both markets. Occasionally, very similar items get sold for multiple purposes with minimal differences. However, the civil PPE market is driven by fundamentally different (and diverse) requirements for emergency response, industrial hygiene, and workplace safety requirements and specifications.

What the Products Are

Given that masks of many kinds are being talked about during the current pandemic, comparatively few people actually know much about how they work, based on the mistruths circulating on social media. The author's own experience in both military CBRN defence and civil protection are that few users of such technology have a good understanding of how CBRN respiratory protection actually works.

From a layman's visual examination of the 50 or so masks that comprise the vast majority of the military CBRN product line-up, there are numerous similarities. Masks or respirators, whichever term you use, are largely made from rubber. Many different types of rubber are in current use, including proprietary materials. Eyepieces, usually polycarbonate, allow the wearer to see. There are numerous types of configuration on the market, with single large plates or smaller dual eyepieces. Filter canisters are either centrally mounted or to one side. The masks with side-mounted filters are usually adjustable so that that filter can go to either side. This is to accommodate military personnel who will need to hold a rifle or machine gun to their cheek. Military respirators generally come in three or four sizes. The vast majority of military CBRN respirators work on a "negative pressure" basis. They are, in the terms used by the trade, referred to as "air purifying respirators". For those who are curious, the alternative in respiratory protection is positive pressure "supplied air" devices such as self-contained breathing apparatus (SCBA) supplying air from a storage bottle. These provide the highest degree of protection and are often worn by firefighters or in industrial applications where safety is paramount. SCBA is not a viable option on the modern battlefield, so military CBRN masks use filters to cleanse the air of hazards. Having noted this, SCBA positive pressure devices are widely used in naval settings for firefighting and in some specialist military CBRN response teams.

Military masks are described as negative pressure because they rely on the wearer to inhale, thus temporarily creating a negative pressure differential on the inside of the mask. This temporary negative pressure sucks air through the filter and a critical inlet valve. Exhalation does the opposite, temporarily creating a positive pressure differential, pushing spent air out of the mask. This continuous cycle of inhalation and exhalation requires depending valves, a good filter, and a mask that is well fitted to the user. Any lapse in those three factors endangers the wearer. For this reason, military CBRN masks have to be produced to a high-quality standard. It should also be noted that, due to the need to pull air through the filter with every breath, such

Photo: Avon Protection

The FM50 mask with and FM61EU filters produced by Avon Protection

Author

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devices always have breathing resistance. Historically, such breathing resistance has been burdensome on wearers, so manufacturers work hard to make sure that filters and the respirator itself has as low a resistance as possible while still maintaining its protective properties.

Powered Air-Purifying Respirators

There is also a category of CBRN known as a "powered air-purifying respirator" (PAPR) which combines many of the features of both traditional negative pressure masks and positive pressure devices. These PAPR devices generally work with a powered blower that pushes air through the same types of filters as normal negative pressure respirators. A PAPR has certain advantages over negative pressure masks. The air supplied by the blower effectively converts the mask into a positive pressure device and in doing so reduces breathing resistance. PAPRs are by necessity heavier, due to the need to have a blower and batteries. PAPRs were rarely if ever seen in military service, being more common in occupational safety and emergency response use. However, there are several market trends at present. Most manufacturers are producing their respirators or at least a variant of their respirator facepiece so that they can be used with PAPR or SCBA equipment. Some manufacturers such as Avon Protection are actively pushing PAPRs for specialist military applications.

Photo: Avon Protection

Avon Protection`s MP-PAPR (Multi-Position – Powered Air Purifying Respirator)

Photo: Dräger

The Dräger M2000 is a standard military respirator. A filter replacement within seconds minimises the risk of contamination. Two compatible filter types, the NATO standard round thread filter and the Dräger F2000 plug-in filter, make the mask flexible for the most varied military user groups.

Finally, there are specialist configurations of military masks for specific military users. The two specialty constituencies within modern militaries are generally armoured vehicle crew and aircraft crew. Such masks need to be designed to integrate into existing vehicle communication systems and helmets. They often plug into existing air supply systems.

How Filters Work

It is worth understanding how military CBRN filters actually work. Modern filters, whether they are for individual gas masks, or larger systems for ships and tanks, use multiple techniques to actually do their work. A filter's most primitive action is sieving. Particles too big to pass through the pores in the filter media are simply blocked. However, while this is a key feature in, say, protecting against nuclear fallout, this is a very small part of the overall action of how a filter works. Present day conspiracy theories and mistruths about pore size and masks are now commonplace in the COVID-19 pandemic.

Other actions include interception and inertial impaction. The pores in a filter will not line up in a straight line, so many particles or droplets will hit the filter media, regardless of theoretical pore size. Even more important is electrostatic attraction. Electrostatic charges on the filter media attract particles and droplets, causing them to stick to the filter material.

With military masks, which are generally made with activated carbon, adsorption is a key factor, particularly for threats which are true gases like phosgene or chlorine. This is why, for a century, activated carbon has been the prime material for such filters. If properly treated, a single gram of activated carbon can contain dozens or even a hundred square meters of surface area. Adsorption (note the 'd' not the 'b') is when a molecule of gas or vapour gets trapped on the surface of a particle, such as activated carbon. The volume of a particular mask filter element is often driven by calculations as to how much material may need to be adsorbed over a period of time.

Yet another particular feature of many CBRN masks is the use of small amounts of reactive chemicals to enhance filtration. Some chemical warfare agents and toxic industrial chemicals, such as hydrogen chloride and cyanogen chloride, are not easily captured by the various other methods mentioned above. Historically, chromium, copper, nickel, and silver compounds have been used to react with such hazards and generally increase the overall efficacy of CBRN filters. In the past, it has meant that some types of filters have posed environmental problems when it came time to dispose of them.

It should also be noted that no mask filter is good for indefinite use. Even exposure to ambient air entails exposure to moisture which will, over time, consume some of a mask filter's capacity to adsorb hazards. Both manufacturers and militaries publish "filter exchange criteria" that specify the time intervals, often shorter in humid climates, for exchanging filters. It should also be noted that it is common practice to use older filter elements in training environments as an economy measure.

A final note about CBRN filters for protective masks is interchangeability. Standardisation, particularly driven by NATO, has led to the state of affairs where there are only a handful of different fittings for the numerous filters and masks out on the military market. An Italian mask can usually take an Israeli filter. The current standards which is most prolific is NATO STANAG 4155, which specifies a 40mm screw mount filter with a 1 turn in 7 screw thread. Filters made to such standards still prevail, although the US military has received some criticism for

turning away from this standard with its M50/M51 Joint Service General Protective Mask (JSGPM).

Fit Validation

The nature of military masks, with their negative pressure operation, various sizes (but often only S, M, and L sizes), and a wide variety of sizes and shapes of users' faces means that having a good fit can be the difference between safety and injury. Ensuring a proper fit is necessary to force protection. For many decades, there have been qualitative methods to check the fit of a mask. These have often been on the crude side – holding a hand over the filter and inhaling to see if the mask collapses around one's face. This is simple and roughly effective. Other tactics have involved using safe substances with strong odours – isoamyl acetate, which reeks strongly of bananas, can be used to see if the mask leaks. At the beginning of this author's career, these were the common methods.

Such qualitative fit-testing methods, while time-honoured, have fallen into disrepute with respiratory protection professionals over the years and are felt to be broadly inferior to quantitative testing methods. There are now specialty machines designed to specifically measure how good (or bad) a particular mask fit might be. For example, a specific device, the M41 Protective Mask Fit Validation System, was revolutionary in the US Army. Fielded as part of the rollout of the M40-series protective mask, it could give actual measurements. It also, at least anecdotally, pierced some of the perceived wisdom. Some soldiers with apparently good fits "validated" by the older techniques did not actually have good fits after all.

Quantitative fit testing is now an industry unto itself, and one that has spawned a small industry of its own and has spilled over into civil applications. The US firm TSI, based in Minnesota, has a global footprint and has established itself as a market leader in this segment. The aforementioned M41 is their product. Fit testing is also heavily marketed as a service, not just as testing equipment.

Dynamics of the Market

Protective respirators have been standard issue for many decades in all of the major militaries. All of the major militaries around the world field protective masks to their soldiers, making it easy for a vendor to estimate the size of the market. Respirator and filter orders can be as large as hundreds of thousands of units. However, the technology only evolves gradually. The US Army and British Army, as a pair of examples out

Photo: MoD Australia

An Australian Special Forces operator using the newly issued AirBoss "Low Burden Mask" (LBM). The LBM became the new standard issue gas mask for the Australian Defence Forces in 2019, and is slowly replacing the old ADF-10, Australia`s variant of the.

of many, change their general use mask about once every few decades.

A typical business cycle could be generalised. A new requirement, based on improved technology or possibly a change in standards, results in a new competition for a major national-level contract. Fierce competition occurs, with a predictable short list for a particular market. The winner makes much money on the initial buys and a bit of residual income on replacements, spare parts, and related income. They repackage, slightly, the mask that they made for the major contract and try to sell it elsewhere in the world. Sometimes, this is done with much success and sometimes without any at all. If a general rule of thumb were to be developed, it would be that the larger, more diversified companies have a somewhat better record of selling to the global marketplace and not just their own domestic marketplace.

As with some other types of defence commodities, a lot of national-level manufacturers have evolved. A number of companies evolved over time who service their national market and tend to service those markets well, but sometimes have trouble getting outside their domestic markets. The extent to which these particular national markets are officially or unofficially protected is one for active debate elsewhere but the subject of lengthy discussions inside the industry.

Manufacturers in this Market

This is a large, mature market segment. Some of the major players evolved out of other markets, such as rubber or mine safety equipment. Mergers and acquisitions have also affected the line-up of companies in CBRN respiratory protection. Some long-standing names have changed ownership, while others are less prominent than they once were, having lost competitions for major contracts.

Avon Protection (UK), which is a brand underneath the venerable Avon Rubber, is one of the leading manufacturers and arguably the global leader in the space. They won the US contract to make the M50 JSGPM and its specialty variants. This mask gets sold as the FM50 or C50. Their FM12 and S-10 masks are in service in at least 25 countries.

For many years, Scott Safety (USA) was a venerable brand in this space. It has been acquired by 3M (USA) and has a credible product line. It supplies the General Service Respirator for the UK MOD, and has its M-series masks in use in about 20 countries around the world. It should be noted that 3M is also a world leader in the production of filter elements. MSA (USA), a venerable supplier, which produced the M17-series of mask for decades both for the US and its allies, does not have the market penetration it once did. But its "Millennium" series-mask is a credible offering. The M17 mask or copies continue to be seen around the world. Between them, 3M and Scott are also the major players in the SCBA market.

ILC Dover (USA) once skyrocketed to prominence in this market with the M40 series masks for the US military, does not have a great market presence outside the USA. They continue to service legacy M40 users.

Dräger (Germany) is a key European player in this market, although its products are more widespread in civil protection and emergency services than in military markets. Their M2000 is their standard offering in military masks. NBC-Sys (France) serves not only the French market, but a reasonable export market as well, with their ARF-A/ARFC series of mask in use in at least 10 markets. Air Boss (Canada) serves an export market beyond its domestic market as well. Their relatively new "Low Burden Mask" has been selected for the Australian military and also replaces Air Boss's C4 mask for the Canadian military.

Gumárny Zubří (CZ) serves a number of Eastern European markets. NewPac, in Sweden, serves some valuable export markets beyond its own traditional Nordic client base and bears watching. Nokia (Finland) formerly produced masks but is out of the business. Beyond these main players, various smaller companies serve primarily National markets. Zebra (Bulgaria), Sekur (Italy), Biana (Greece), and Maskpol (Poland) are examples of companies serving largely local requirements. ■

Contract Management in Australia

Stephen Bunce

Defence contracting in Australia is a highly organised, regulated, and thorough process undertaken by the Australian DoD and its agencies. In-fact some of Australia's flagship Defence procurement programmes such as LAND 400 and SEA 1000 have attracted international attention to Australia's procurement style, processes, and guidelines.

According to the latest November 2020 Australian National Audit Office (ANAO) Major Projects Report (MPR), a total of 25 current major defence projects were reviewed to the tune of AU$78.7Bn. This total according to the ANAO reflects a cost increase of AU$24.2bn more than when these programmes achieved second pass approval. Despite the cost increase, ANAO notes only 5 out of 25 of the projects have experienced in year scheduled slippage whilst there is an impressive 98% expected delivery against agreed scope over the 25 projects. Further, 19 of these 25 projects are projected to deliver all their capability requirements. With Australia's Defence acquisition agenda not immune from the global impacts and delays caused by of COVID-19 this indeed is quite an impressive feat.

Attracting further international interest, Australian defence funding is forecast to exceed AU$270bn over the following decade through to 2030. This comes as a backdrop to Australian Prime Minister Scott Morrison's recent announcement of a more aggressive defence strategy aimed at deterring China's military advances in the region and amid concerns of greater instability in the Indo-Pacific region. With all indications pointing to an increase in procurement activity, it is vitally important for all current and potential contractors to Defence to understand Australia's national framework for procurement activity.

Photo: Rheinmetall

The Rheinmetall LYNX KF41 is one of the contenders for the LAND 400 programme.

Australian Defence Procurement

In a similar fashion to other Australian federal government agencies, the DoD are subject to the Public Governance, Performance and Accountability Act 2013 (PGPA Act), which establishes a framework for expenditure of public resources. The DOD has a single procurement policy framework that is managed by the Capability Acquisition and Sustainment Group (CASG). CASAG is Australia's central procurement agency acting essentially as a shared service organisation which helps to facilitate access of capability managers to that of industry capabilities themselves.

Requirements for procurement are contained in the Commonwealth Procurement Rules (CPRs) issued under the PGPA Act. The rule set which was last updated in December 2020 are the keystone rules underpinning the DOD's procurement activity. The CPR's emphasise sustainable and equitable procurement practises and the maximising of value of money to the Australian Government and the taxpayer through the encouraging of competitive market tendering and accountable, non-discriminatory purchasing practises. The Australian Government's approach to Defence procurement demonstrates a commitment to the adherence of the CPR's reflecting a standardised rules-based approach, greater accountability on its procuring agencies and an emphasis on maximising 'social benefit' out of its contracts.

For most Defence procurement programmes in Australia, prospective companies typically engage in an open tender process which involves an open approach to market that invites submissions from tenderers through a request for proposal. Projects that are below the value set out in the CPR's division 2 thresholds and where the Defence Procurement Policy Manual (DPPM) considers a procurement as low risk, the process generally can be conducted on a limited tender basis. This involves either a single or several potential suppliers being invited to submit a response in lieu of the open tender process. Defence may also utilise a limited tender for a procurement at or above the relevant threshold where it is exempt from division two regulations under Appendix A to the CPRs. These procurements are usually either designated as an 'essential security interest' or alternatively because they meet the specified conditions for limited tender under certain clauses of the CPRs. In March 2017, the CPRs were updated to require all Commonwealth

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entities to consider and manage their procurement security risk in accordance with the Australian government's Protective Security Policy Framework (PSPF).

Defence's 'Five Pillars' Strategy

Australian Minister for Defence Industry Melissa Price MP last year announced the Australian Government's 'five pillars' strategy. This suite of initiatives promises a new and enhanced Australian Industry Capability (AIC) contractual framework, an independent AIC Plan Audit Programme, an update to the CPR rules and reviews into the Centre for Defence Industry Capability (CDIC) and the Australian Standard for Defence Contracting (ASDEFCON). The strategy will also investigate further ways to maximise Australian industry participation and sovereign capability and the benefits of initiatives such as the Australian Industry Capability Roadshow.

One cornerstone feature of this announcement was a wide-ranging review into ASDEFCON and Defence procurement more generally. The review aims to identify solutions to cut red tape and to ensure a fit for purpose procurement system remains in place to support Australia's AU$270b roll out in defence capabilities over the next decade.

According to the DoD, ASDEFCON provides a suite of contracting and tendering templates which supplies a set of proforma documents for use by procurement officers when drafting solicitation documents and contracts for the acquisition of goods and services by Defence. A recent government survey that engaged local industry stakeholders however identified the concerns of small and medium sized enterprises (SMEs) about the complexity of ASDEFCON templates and the significant time and effort that they take to appropriately respond to. One of the key objectives of the review will be to find solutions to simplify and streamline the templates not just to allow Australia's local SME defence industry to more efficiently respond but also to enable prime contractors a better understanding of how local companies can best fit their capability requirements.

Photo: Hanwha

The armoured REDBACK AS21 IFV manufactured by South Korean Hanwha is another contender for LAND 400

LAND 400

Australia's multi-phase LAND 400 programme is using a three-stage competitive evaluation and risk mitigation approach. The programme is the largest and most expensive acquisition project in the history of the Australian Army tasked with managing the delivery of an entire fleet of over 600 of the next generation of armoured fighting vehicles.

Phase 2 of the LAND 400 programme to acquire 211 Rheinmetall BOXER combat reconnaissance vehicles is largely tracking on schedule and budget according to a report ANAO released in November last year. Whilst the report concludes phase 2 of the programme has largely been effective to date and has potential to achieve value for money outcomes, the programme did not entirely escape the watching eyes of the national auditor. The report notes three prior Defence reviews on this programme's approach to market that led to tendering and schedule constraints, which had the potential to discourage potential bidders to participate in the tendering processes. This had the potential to limit competition and options available to the Commonwealth remarked ANAO. Various deficiencies in the risk mitigation process were also flagged to have undermined the effectiveness of the tender evaluation processes. Further, ANAO noted over 10 contract change proposals have been signed since 30 June 2020 which has effected 175 changes to the contract between Rheinmetall and Defence and adding around AU$130M in costs to the programme.

Also tracking largely on schedule is the AU$15Bn LAND 400 Phase 3 programme to acquire a largely military of the shelf (MOTS) replacement of up to 450 infantry fighting vehicles (IFV) to replace Australia's current M113 armoured personnel carrier. The second and current stage is the Risk Mitigation Activity (RMA). In this stage the Australian Government is engaging selected finalists Rheinmetall and Hanwha who have delivered their LYNX and REDBACK IFV offerings to undergo rigorous trials and evaluation between late 2019 through to the end of 2021.

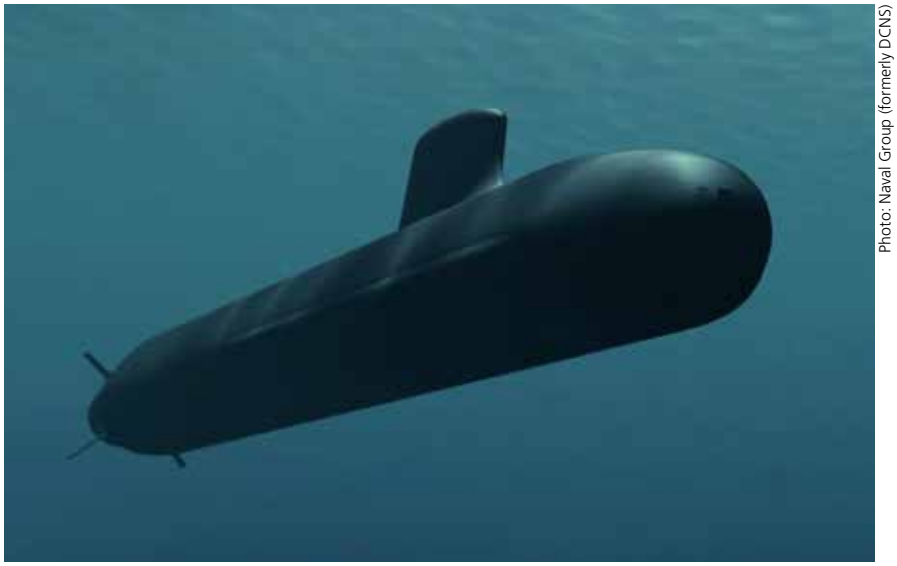

Photo: Naval Group (formerly DCNS)

Australia´s ATTACK class submarine programme is the largest defence procurement in the nation's history.

Photo: Lockheed Martin

The Royal Australian Air Force will operate the F-35A Conventional Take Off and Landing variant. Australia's programme of record is for 72 F-35A aircraft.

The benefit of RMA process is that it is allowing the DoD to currently carry out extensive technical and programmatic assessments of the two proposals whilst it also affords finalists the opportunity to refine and negotiate their offers as the process evolves. Both company's IFV offerings will be put through a very thorough testing and evaluation regime conducted by the Australian Army where the vehicles will also be operated and tested in some of Australia's most versatile terrains and extreme conditions.

After the RMA process, the two shortlisted tenderers will submit final offers which will be subject to financial evaluation with the preferred tenderer presented to the Australian Government for consideration in 2022. The Commonwealth will then move to stage 3 which is the final evaluation and selection process for the successful tenderer.

The Australian Naval Shipbuilding Plan

In March 2020, Prime Minister Morrison announced the establishment of a new cabinet committee to tackle increasing concerns about the roll out of Australia's ambitious National Shipbuilding Plan first announced in 2017. The announcement should come as no surprise as the National Shipbuilding Plan has been beset by various cost blowouts and delays, contractual disputes, design issues and public criticism about insufficient local industry engagement particularly concerning Australia's AU$90Bn future submarine and AU$45Bn future frigate programmes.

The Australian DoD is largely adamant that the SEA 5000 HUNTER class future frigate programme being delivered by Britain's BAE Systems is tracking as planned and without major issues. Concerns have however been raised by industry leaders and political figures that Defence has not done enough to avoid the similar issues faced by Canada's next generation frigate programme which has been beset by significant cost blow outs, delays, and increasingly complex design issues. With the core of Australia and Canada's future frigate programmes based on the same British Type 26 Frigate one thing is for sure Australian Defence officials will be closely monitoring developments both in the UK and Canada. Only time might tell how well Australia will succeed in delivering the first of the combat ships for service in the late 2020s on time and on budget.

Photo: Australian DoD

The SEA 5000 HUNTER class frigate project is one of the largest projects being undertaken by the Australian DoD, second only to the SEA 1000 submarine Project. It will provide nine anti-submarine warfare (ASW) frigates to replace the current ANZAC class fleet.

SEA 1000 – A Competitive Evaluation Process

In February 2015, in what was considered a departure from several already shortlisted MOTS options, the Australian Government announced its acquisition strategy for SEA 1000 which will become Australia's largest ever rolling Defence acquisition programme. The cornerstone feature of the announcement would be the requirement that Defence team with an international partner to design and build Australia's new ATTACK class of future submarine. France's Naval Group (then DCNS), Germany's TKMS and the Government of Japan were invited to participate in a competitive evaluation process (CEP) to select Australia's future design and build partner. Later in April 2016, Naval Group were selected as the successful partner for the design and future build of the 12 submarines.

In January 2020, Australia's National Audit Office (ANAO) handed down its latest audit report into the ongoing submarine mega programme. The latest report in comparison to the April 2017 report on the design of programme's CEP detailed many more concerns with the project than initially identified. The

report in its findings affirms that the decision to forgo the option to acquire a MOTS option as originally considered and instead going down the pathway to engage a strategic partner for the design and delivery of the submarines had indeed considerably increased the risk of the programme as already identified by Defence. ANAO also noted that the programme was experiencing a nine-month delay against Defence's predesign contract milestone while two other major contracted milestones had also been extended. The report remarked the extension of the two major design milestones notably, the Concept Studies Review and the Systems Requirement Review could not demonstrate that the AU$396M spent on design of the Future Submarine was fully effective in achieving the programme's two major design milestones to date.
ANAO also reaffirmed Defence's recognition of differences in commercial and engineering approaches of that of Defence and Naval Group and how it has likely impacted the progress of the programme to date. ANAO also noted a delay of the Future Submarine Programme of more than three years would create a capability gap in the RAN's submarine capability. Therefore, the report affirms that Defence's plan for a life of type extension for Australia's current COLLINS class submarines would be necessary to manage such capability gap.

Australia's F-35A Rollout Progressing Well

Australia's AU$17Bn Air 6000 Phase 2A/2B Programme to acquire 72 Lockheed Martin designed F-35A Lightning Joint Strike Fighters (JSF) was declared by the RAAF to have met an on-schedule initial operating capability in December 2020. So far, over 30 of the JSFs have been delivered to Australia. The latest ANAO MPR does however recognise the complexity of the international collaborative aspect of the programme and the varying challenges it faces especially during the Covid- 19 Pandemic. Therefore, the likelihood of the programme meeting its scheduled final operating capability in December 2023 is a little more uncertain.

Prospects for Defence Contracting in Australia

Australia has generally proven itself as a global leader in the defence acquisition domain with its highly regulated, thorough, and objective driven procurement agenda. Although Australia's big ticket acquisition programmes such as SEA 1000 have been affected by cost blowouts and delays, stringent procedural oversight and auditing have generally been effective in identifying risk, concerns and in offering solutions for projects which have deviated off course.
Australia's approach to contract management very much requires perspective vendors to Defence to familiarise themselves with the myriad of Defence procurement policies, the CPR's and contracting template that govern the procuring conduct between Defence and business. These can be considered burdensome for some, but much is being done through the various 'five pillars' initiatives such as latest review into ASDEFCON to streamline processes and the ease of contracting with Defence. One thing is for sure with over AU$270bn projected to be spent by Defence over the following decade through to 2030 opportunities are abound for companies big and small, locally and from abroad to enter Australia's defence supply chain. Therefore, taking the time to fully understand Australia's approach to Defence procurement and contract management has never been more important. ■

Masthead

European Security & Defence
Issue 6/2021, June 2021
ISSN 1617-7983 · www.euro-sd.com

Published by

Mittler Report Verlag GmbH
A company of the TAMM Media Group

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Layout:
CREATIV.CONSULTING GmbH, Germany

Production:
Lehmann Offsetdruck GmbH
22848 Norderstedt, Germany

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Cover photo: Raytheon ELCAN

Annual subscription rate: €82.50 incl. postage

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"We see an increasingly complex threat environment."

Photos: TCI

Based in California, TCI International, Inc. is an export-oriented provider of spectrum monitoring, SIGINT and geolocation solutions. ESD spoke with Kevin Davis, Vice-President of Product and Channel Management.

ESD: In 2018, you celebrated TCI's 50th anniversary. What has changed over time, and what are the most current trends in the domain of the electromagnetic spectrum?
Kevin Davis: TCI was founded more than five decades ago by a group of innovative engineers with a problem to solve: How can you reduce rework, schedule and cost for large array antennas? The company pioneered the use of computers to simultaneously design mechanical and RF characteristics of the antennas – removing errors caused by independent manual calculations. In doing so, the company not only significantly reduced design and implementation costs, plus delivery schedules, it amassed crucial RF spectrum monitoring and management expertise. Today, we help national governments monitor and enforce spectrum licensing regulations, while providing allied military forces with signals intelligence systems to help personnel detect, collect, analyse and locate RF signals with speed and precision. As we survey the security landscape today, we see an increasingly complex threat environment. There are more actors able to pose a threat and their CONOPS has become more varied, such as through the use of drones, and thus more crucial to identify. The rise of 5G and other high frequency technologies represent an additional challenge to COMINT due to how they work and how we anticipate they will be used in the coming years. Finally, we are closely tracking advances in radio frequency machine learning and see great potential in this and related forms of artificial intelligence.

ESD: TCI is today a subisidary of SPX Corporation. Can you say a few words about the company's origin?
Davis: SPX began in 1912 as the Piston Ring Company based in Michigan and specialising in original equipment components for the automotive industry. After acquiring the Accuralite Company in 1931, the company changed its name to Sealed Power Corporation and started manufacturing piston rings, pistons and cylinder sleeves for military applications. A series of additional acquisitions led the company to change its name in 1988 to SPX Corporation. Today, the company is a supplier of highly engineered products and technologies, holding leadership positions in the HVAC, detection and measurement, and engineered solutions markets. It is based in Charlotte, North Carolina, with more than 4,500 employees in 17 countries. SPX Corporation is listed on the New York Stock Exchange under the ticker symbol SPXC.

ESD: In your niche, you are a supplier to more than 100 countries. Where are your core markets?
Davis: For civilian spectrum monitoring, TCI's top markets are primarily in developing nations, especially those in Asia and Africa. However, we also serve select counties in Europe, South America and North America. The COMINT side of our business is driven largely by the threat environment, thus Europe and Asia are particularly active at present. Yet threats exist elsewhere, so our equipment can be found throughout the world, including in countries that may not in the headlines daily but need to protect their borders, territorial waters and other assets. Our solutions are trusted by US and allied military, UN peacekeeping forces, border security agencies, law enforcement and the intelligence community.

ESD: You certainly face strong domestic competition on the European market. What are TCI's selling points here?
Davis: TCI has sales and support offices in 13 countries supporting an installed base in more than 100 nations. Europe has been a key market for us and the unique threat environment there has driven strong interest and procurement for our COMINT systems. We are continuously improving the capabilities and performance of these systems to provide faster signal intercept and analysis, more accurate geolocation, greater CONOPS flexibility, more reliable communications in high- and variable-latency data links, and the ability to react faster on the front line. We believe these innovations and more than three decades of superb customer support will enable us to remain a trusted provider of choice in Europe and elsewhere.

The interview was conducted by Andreas Himmelsbach.

Mobile and portable COMINT equipment is part of TCI's core portfolio.

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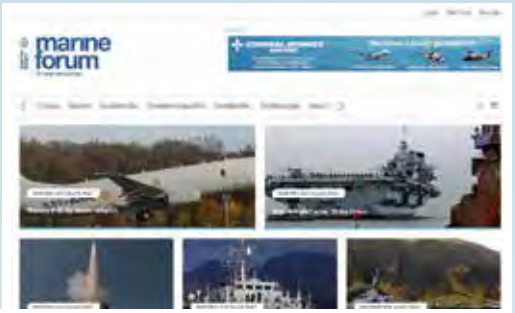

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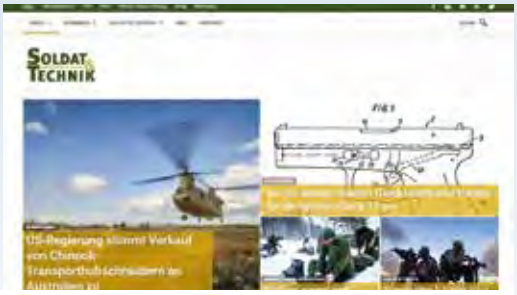

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"Our ASCOD is the only platform in the current Czech competition which can be adapted to a medium main battle tank."

Photos: GDELS SBS

With more than 2,000 highly skilled employees, GDELS companies design, manufacture and deliver wheeled, tracked, and amphibious vehicles and other combat systems such as armaments and munitions to global customers. As one of the European leaders in the land combat systems sector, GDELS is currently offering its tracked ASCOD platform for the Czech Army's IFV requirement. ESD had the opportunity to speak to Juan Escriña, GDELS Vice President for Tracked Vehicles & Artillery and Managing Director of GDELS-Santa Bárbara Sistemas (SBS).

ESD: What are the main military programmes your company is already developing?
Escriña: GDELS-SBS is currently working on multiple programmes for armies of different countries worldwide for tracked, as well as for wheeled vehicles.
Our tracked vehicles are based on the ASCOD platform. With its modular design and open system architecture, the ASCOD can be customised easily for multiple roles, including that of a Light Tank (LT) or Medium Main Battle Tank (MMBT), and can be equipped with large-calibre cannons up to 120 mm. Four nations (Austria, Spain, United Kingdom and an Asian-Pacific customer) have already chosen the ASCOD as their preferred tracked armoured vehicle platform.
Currently, we are working for the Spanish Army on the PIZARRO (ASCOD) family of armoured vehicles, and the advanced Engineering Combat version (ECV), called "CASTOR" (Beaver). The Spanish Army is testing the prototype prior to beginning the manufacturing phase. The programme is an innovation milestone for this kind of specialised vehicle in terms of protection and capabilities.
Furthermore, we are working in close cooperation with General Dynamics UK on the multi-variant AJAX programme for the British Armed Forces. The coming years will be particularly exciting as we are witnessing the entry into service of highly innovative armoured vehicles, setting a new benchmark for the armed forces of the 21st century.

ESD: And the VCR 8x8 DRAGÓN is the key programme for the coming years in Spain.
Escriña: With regard to wheeled vehicles, GDELS-SBS is working on the new 8x8 armoured vehicle for the Spanish Army, namely the VCR 8x8 named DRAGÓN, based on the PIRANHA V platform. The project comprises 348 vehicles and was contracted in 2020 to Tess Defence, a collaboration of various Spanish companies such as SBS, Indra, EM&E and SAPA. The DRAGÓN is manufactured and integrated at our factories in Asturias and Andalucía. GDELS-SBS is also responsible for the development of the vehicle's protection package and the open electronic architecture.
Finally, we are carrying out the mid-life upgrade and maintenance of PIRANHA IIIC vehicles for the Spanish Marines.

ESD: Which new projects are you expecting for the coming years?
Escriña: We are closely collaborating with various European and NATO countries, which are planning to replace or upgrade their ageing vehicle fleets. Our GDELS value proposition clearly focuses on the highest levels of survivability, affordability, commonality, interoperability, multi-role, and future growth potential, as well as optimisation for military mobility, one of the priorities for the European Union and NATO for the coming decade. In line with this military and political prioritisation, GDELS has recently been supporting the widely recognised military mobility initiative of the transatlantic think tank, CEPA, under the leadership of General (ret.) Ben Hodges.
When it comes to "multi-role" and "future growth potential," our ASCOD is the only platform in the current Czech competition, which can be adapted to a Medium Main Battle Tank (MMBT) variant with large calibre cannons (105 mm to 120 mm), and a tracked, self-propelled 155 mm cal. 52 howitzer system or to a Multiple Launch Rocket or Missile System.
In order to maintain General Dynamics' global leadership in tracked and wheeled vehicles, we will continue to invest in advanced innovative technologies. We have defined a path and a product strategy for the ASCOD, which, in combination with our industrial cooperation model, is very attractive for our customers. With four customers currently and more than 1,000 vehicles in service or under contract, the ASCOD is the best military and industrial option to master the military require-

ments and fulfill the understandably high expectations of the Czech Army. We are confident that after a fair, competitive process, the Czech customer will decide on the best available solution, also taking into account GDELS' excellent record of achievement and longstanding, trusted partnership with the Czech Republic and its Armed Forces.
GDELS possesses advanced technology solutions for armoured vehicles and artillery programmes, which the Spanish Army is determined to include in its modernisation project "Fuerza 35". In this regard, we have recently presented a new variant of the PIZARRO/ASCOD family for special roles and missions. Using our Common Base Platform (CBP) concept, the Spanish Army will have the same platform for most of the support and specialist vehicles for its mechanised units. The new variant of the PIZARRO – also known as "CARGO"- will serve as a substitute for the old M113, M109 or multi-rocket vehicles. This new contribution will considerably reduce the cost, as well as the logistic footprint, while increasing the efficiency and operability of the entire fleet.
Last but not least, GDELS-SBS is ready to support the Spanish Army in their plan for a potential mid-life upgrade of the LEOPARD 2 E.

The new VCR 8x8 armoured vehicle for the Spanish Army's DRAGÓN programme

ESD: What challenges is your company facing in the COVID context?
Escriña: Since the company operates on a global scale, we are of course not unaffected by the constraints, challenges, and economic implications of the ongoing pandemic. Since our primary concern is the health and safety of our employees, we established a robust COVID protection programme across our entire organisation at an early stage of the crisis. Due to national legislation, we also had to manage mandatory shut-downs at some of our factories and have been fully focused on mitigating any negative impact on our operations. We are proud that through the extraordinary efforts of our entire GDELS team, we have been able to adapt to these challenges quite successfully. Beyond these efforts to minimise negative effects on our own company, our solidarity and support extends to our numerous industrial partners, in particular to suppliers and small companies, which in many cases have greater difficulties to master the current struggles.

ESD: Where do you see new opportunities for your company?
Escriña: On 1 January 2021 the European Defence Fund (EDF) started with a total agreed budget of €7.953Bn for the 2021-2027 period. The EDF will be scaling up the funding for collaborative research in innovative defence products and technologies and for subsequent stages of the development cycle, including the development of prototypes. It aims at fostering the competitiveness and innovativeness of the European defence technological and industrial base thereby contributing to the EU's strategic autonomy. It also aims at triggering cooperative programmes that would otherwise not happen without an EU contribution and, by supporting research and development activities, to provide the necessary incentives to boost cooperation at each stage of the industrial cycle.
Spain, with its diversified, strong defence industry is very much supporting this historic European initiative. The Spanish defence industry is well prepared to contribute to EDF projects and to embed its stakeholders into respective consortia. GDELS-SBS, together with 35 industry partners from 15 EU Member States, has applied for funds provided under the European Defence Industry Development Programme (EDIDP) and is determined to continue this important collaborative work through the EDF.
GDELS-SBS' unique proposal is our professional approach and customer-oriented flexibility in respecting certain sensitivities while accommodating different national interests, and remaining open for changing industrial partnerships. We are determined to further strengthen our positon as a key player in land systems, which necessitates continued investment and efforts in new technologies and innovation, particularly in three areas: digitisation, automatisation, and energy management (electrification). While we are prioritising these areas of technological innovation, we will of course remain dedicated to our core value proposition regarding protection, mobility and commonality.

GDELS is offering the ASCOD in the current Czech competition.

The interview was conducted by Esteban Villarejo.

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