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Who Cares?

Military operations, if they are to be successful, tend to start with an "Appreciation", looking at, identifying and assessing an enemy's strengths and weaknesses. Some nations' armies grind down to the essence of things by asking, repeatedly, "So what?" Hence "This shady single-track lane through the trees, banked on both sides, would be a good ambush position." "So what?" "So, let's not go that way."

In business, politics, philosophy and psychology the equivalent process is driven by "Why?" – or even "What if?" – driving towards an answer, and even, possibly, the – or in modern parlance "a" – truth. The distinction is important, because in domains other than the military truth can readily change, given time: in military operations the truths of victory or defeat are clear.

In terms of military procurement, however, the larger truth becomes obscured by the detail. Who cares, in the end, if the UK's armoured vehicle industry becomes defunct, or if Germany's naval shipbuilding industry withers, or France's small arms ammunition manufacturing capability disappears? When these and other European sovereign capabilities shrink to nothing there is almost always a political factor at play, normally in the form of diminished budgets and fading political will. Those are the answer to "Why?" and what remains is "What if…?" Unfortunately, that critical question that can lead to leaps of imagination, logic and capabilities has metastasised into a quasi "So what?" that actually masks "Who cares?"

Sticking with security and defence procurement, we should all care.

Some truths are self-evident, such as the terminal unlikelihood of the F-35 Joint Strike Fighter achieving its mandate of being a cheap and plentiful successor to the F-16, or the fact that if a rifle is procured to meet a set Bundeswehr specification and fails a different (operational) test the failure is in the specification or the test, not the weapon.

Some truths are too true to be acknowledged, and that includes the awe-inspiring – not a positive! -handling of national and supra-national budgets around the world, and the national debt being bequeathed to current and future tax-payers, particularly in the West. A recent non-partisan study in the US determined that the actual budget deficit in the US amounts to US$123Tn, or nearly US$800,000 for every single tax paying American, while in Brussels the EU has introduced a new "social reform" initiative, to be administered by Brussels, on top of the GBP 676Bn coronavirus recovery find (characterised in the US as miserly)… Fortunately, the "Frugal Four" – Austria, Denmark, the Netherlands and Sweden – plus Bulgaria, Estonia, Finland, Ireland, Latvia, Lithuania and Malta – are challenging that proposal, but it really should not have become necessary. In the meantime, France and Germany continue to throw money at their problems, though the Gilets Jaunes have not gone away, and the emergence in Germany of an environmentally "aware" but naïve and inexperienced political force is scant reassurance for the man in the street (consider me censured) – even if that same voter is responsible for it. The UK meanders along its lonely post-Brexit path, as far as the EU is concerned, while Italy, Ireland, Greece and Spain have yet to recover from that last assault on their finances.

Over all this hangs, like a monetary sword of Damocles: Debt. The current level of divorce from financial reality amongst political and civil service leaders throughout the West is something with which all ESD readers and commentators should be concerned especially as the consequences upon security and defence budgets will be severe and long-term. Waffle about an independent and costly EU Army to replace NATO is not helpful, and debt forgiveness, a form of largesse seen in the past, is purely a (Nordstream) pipe-dream.

President Putin has been mocked for showing his cards on the Ukrainian border over the last few weeks: but the West has shown the extent of and the limits to its responses. Having been able to pre-position war-making materiel and identify any potential opponent's strengths and weaknesses, Putin is well-positioned for a short, sharp, summer offensive while the West gazes at the wreckage of its bank accounts, assures itself that it is fine, and asks itself "Who cares?"

Stephen Barnard

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Photo: Crown Copyright 2020

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Change in the Top Management of Diehl Aviation

Photo: Diehl Aviation

(jh) Rainer von Borstel, Diehl Aviation CEO since 2010, retired at the end of April 2021, handing over the leadership of the organisation to Josef Köcher, who joined Diehl Aviation as COO in June 2020. Köcher will remain COO, taking on the CEO tasks in addition to his previous assignments. He will also succeed von Borstel as member of the Diehl Executive Board.

During eleven years at the helm of Diehl Aviation, von Borstel oversaw a successful growth of the company, integrating several industrial units over the years and managing critical stages of Diehl Aviation's contribution to major new commercial aircraft programmes such as the Airbus A350 XWB and the Boeing 787 Dreamliner.

Also during von Borstel's leadership, Diehl Aviation multiplied its business volume and grew to become a company with around €1.5 Bn annual turnover. At the same time, Diehl Aviation increased its global presence for the purpose of customer proximity in markets around the world.

Before joining Diehl Aviation, Josef Köcher spent two decades in several management positions at Airbus and ArianeGroup, most recently as Head of Production Aircraft & MRO Germany and Head of Site at Airbus Defence and Space in Manching. He holds degrees in Aerospace Engineering and Business Administration.

Leadership Change at RENK

Photo: Renk

(jh) The Renk Group has announced that, subject to her formal appointment by the Supervisory Board, Ms. Susanne Wiegand will assume the position of CEO of the Renk Group as of 01 May 2021. Ms Wiegand will succeed Mr Florian Hofbauer, who acted as the spokesperson of the Executive Board and lead Renk for almost fourteen years. While CEO, Mr Hofbauer has played a key role in shaping Renk by driving growth and innovation while successfully expanding the company's position as a technology leader. Following Ms Wiegand's appointment, Mr Hofbauer will pursue new ventures. Susanne Wiegand is an experienced manager who has already led large and successful companies of the Rheinmetall AG as well as the German Naval Yards shipyard group and ThyssenKrupp Marine Systems. With over 20 years of management experience in corporate leadership, M&A and operations, she brings highly relevant industry experience.

Changes in Airbus Top Management

(gwh) Michael Schöllhorn will take over as CEO of Airbus Defence and Space on 01 July 2021. He succeeds Dirk Hoke, who has led the division for five years and is leaving the company unexpectedly at his own request.

Schöllhorn a former helicopter pilot, joined Airbus in 2019 from home appliance manufacturer Bosch. He is currently Chief Operating Officer at Airbus' Commercial Aircraft Division. He will be succeeded by Alberto Gutiérrez, Executive Vice President Military Aircraft and Member of the Airbus Defence and Space Board.

Photo: Airbus

Sabine Klauke has been appointed Chief Technology Officer (CTO) and Member of the Airbus Management Board. She succeeds Grazia Vittadini, who is leaving the Airbus Group at her own request after more than 19 years. Klauke also takes over the duties of Executive Vice President Engineering from Jean-Brice Dumont, who succeeds Gutiérrez.

Klauke is currently Executive Vice President Engineering and a member of the Airbus Defence and Space Board. She has been with Airbus since 2002 and has been responsible, among other things, for improving the product-related development process and modular industrial design for the new aircraft types.

Terma Opens Office in Indonesia

(jr) Terma has established itself in Indonesia with the opening of PT Terma Technologies Indonesia. The expansion emphasises the company's focus on the country, where it will pursue business opportunities within the aerospace, defence and security sector.

Photo: Terma

The new office represents the third expansion in the Asia-Pacific region after the establishment of Terma Singapore in 2007 and Terma India in New Delhi in 2012. Terma Indonesia joins the Terma Asia Pacific cluster, with direct report to Singapore, which remains the regional headquarters.

Terma's business activities are established in Jakarta and supported by a Programme & Service Office in Surabaya. The Surabaya office will include a workshop, ensuring project management, support & services, engineering and maintenance tasks for Terma's customers.

Terma's solutions are operated in all theatres of operations (air, land and sea) by Indonesian customers including:

- The Coast Guards (BAKAMLA)
- Several international airports, including Jakarta
- The Sea and Coast Guard (KPLP)
- Directorate General of Sea Transportation (DGST)
- The Indonesian Navy (TNI-AL)
- The Indonesian Air Force (TNI-AU).

Iveco Defence Vehicles Marks New Plant

(jr) Iveco Defence Vehicles (IDV) marked the inauguration of its new plant in Romania on 09 April. In December 2019, the company signed an order with the Romanian Ministry of National Defence as part of a framework agreement which includes the delivery of more than 2,900 high mobility trucks. Some months later, in August 2020, the groundbreaking ceremony was held in the Romanian automotive district of Petresti (Dambovita). Construction works have been rapidly completed and the new assembly line, dedicated to the National Armed Forces, is now ready.

Photo: Iveco

According to the contract, series production of the vehicles is expected to begin shortly with an estimated productive capacity of up to 440 units per year, counting also on the production support of IDV's Italian plants.

InVeris Appoints Al Weggeman as CEO


Photo: InVeris

(jh) InVeris Training Solutions announced today the appointment of Al Weggeman as CEO, effective 05 April 2021. InVeris Training Solutions is a portfolio company of Pine Island Capital Partners.

Weggeman has more than 20 years of experience leading teams to deliver sustained growth in engineered component and product businesses serving military, law enforcement, and other customers. He most recently served as President of Block Engineering, LLC, a company specialising in chemical detection systems for military, law enforcement, global government agencies, and process industries. Before that, he was President of L3 Technologies Security & Detection Systems, where he led their global security and detection systems business focused on aviation, transportation, government, and critical infrastructure markets. Weggeman earned an MBA from the Kellogg School of Management at Northwestern University in 1992. He graduated Magna Cum Laude from Northeastern University in 1988.

20 Years of Embraer's Engineering Specialisation Programme

(jr) One of the longest programmes for intellectual and technological development in Brazil, Embraer's Engineering Specialisation Programme, has reached its 20th anniversary.

Conceived from a strategic vision to accelerate the learning process for recently graduated professionals in various areas of engineering to work in aeronautical technologies, the programme combines a professional master's degree from Brazil's Aeronautics Institute of Technology (ITA) with a course to prepare engineers to work in multidisciplinary teams at Embraer. The programme includes courses taught by ITA professors, experienced company professionals and hired consultants.


Photo: euro-sd.com

Over two decades, the Engineering Specialisation Programme has been constantly evolving to adapt the specialisation of professionals to the needs and challenges of the company. More recently the programme has also started to cover courses such as Industry 4.0, Data Science and Project Prototyping in 3D Printer, among others. More than 1,600 professionals have already gone through the programme that has become the main gateway for engineers who want to work at Embraer.

Aeronautics Introduces the ORBITER 4 UAS for Maritime Patrol Missions

As a provider of integrated turnkey solutions based on unmanned system platforms, payloads and communications for defence and homeland security applications, Aeronautics Group introduces its ORBITER 4 small tactical UAS, capable of performing long-range, long-endurance maritime patrol missions.

The ORBITER 4's modern EO/IR and MPR payloads are laid out for maritime monitoring, gas and oil rigs protection, illegal activity tracking, and search & rescue. The system has already been fully integrated into the operational environment of naval vessels, responding to the requirements of naval operations.

With the ORBITER 4, Aeronautics continues the evolution of its ORBITER product line of small tactical UAS. According to the company the systems deliver mission performance as the lightest, most versatile, and most advanced covert platforms available today. Based on the aerodynamic structure and properties of the ORBITER 3 STUAS, the ORBITER 4's capabilities include endurance of over 24 hours, and the ability to carry and operate multi payloads simultaneously.

With advanced image processing capabilities, an automatic takeoff and recovery system, and the ability to navigate with or without GPS/ datalink, ORBITER 4 delivers superior performance capabilities, operational flexibility and cost-effectiveness in a small tactical UAS that is unique in its category, according to Matan Perry, Vice President of Marketing & Sales at Aeronautics. ORBITER 4 is airstrip-independent and able to take-off and land on any type of vessel. Operated by a team of three, the company claims it is easy to use, maintain, and carries a low logistical footprint.


Photo: Aeronautics

ORBITER 4 is suitable for marine border protection and security of sensitive marine facilities.

Mobile GBAD Requirements

(jh) As the likelihood of increased armed conflict looms in the Ukraine, experts at Saab Dynamics – developers of the RBS70 MANPAD - calculate there is a step change in armed forces interest in mobile Ground-Based Air Defence (GBAD) systems. This is due in large part to observations and measurements about changes in strategic military situations and tactics worldwide.

Over the past three decades, western nations - specifically - relied on air superiority as a key advantage, presuming air power alone is best for countering all airborne threats. However, the situation is different today and adversaries are using new tactics that reduce an air force's ability to suppress enemy actions such as Anti-Access / Area Denial.

Enemy indirect fire also threatens the ability to protect troops. These threats are enhanced by the use of UAS as loitering munitions, increasing casualties and limiting or losing operational freedom. More mobile GBAD forces are required to support the "close fight" on the current and future battlefield.

Photo: Saab

Listening to doctrinal experts of various militaries, a convincing case is made about renewed importance for deployment of mobile GBAD systems: Its necessity will increase rapidly to meet airborne threats. In order to keep pace with the constantly changing demands in the GBAD domain, a wide range of system requirements must be fulfilled.

ESD Online continues this discussion with a case study that illustrates how Denmark assessed and adapted to the change in this specific strategic military situation, relying on mobile GBAD systems.

https://euro-sd.com/2021/04/headline/22334/mobile-gbad-capabilities-for-denmark/

Rheinmetall and Northrop Grumman to Cooperate on Artillery Ammunition

(jh) Effective February 2021, Rheinmetall Denel Munition and Northrop Grumman have made a 10-year agreement to cooperate in the field of precision-guided extended range artillery ammunition.

The two companies plan to offer ammunition technology to the international market, including the United States. Above all, the partnership will focus on achieving an enhanced range 155mm artillery round fitted with an integrated M1156 precision guidance kit (PGK), as well as on developing a new 155mm projectile with an improved integrated propulsion system.

Photo: Rheinmetall

In service with a number of armed forces, the M1156 PGK is an immediately available means of enhancing the accuracy of existing types of artillery ammunition. In combination with Rheinmetall's V-LAP projectile, which currently achieves the longest maximum range of any conventional artillery projectile, the M1156 PGK results in a proven solution for long-range precision-guided effect. The longest range ever attained by a conventional artillery projectile currently stands at 76 kilometres, achieved in 2019 at the Alkantpan test range with a non-NATO Joint Ballistics Memorandum of Understanding (JBMOU)-conforming 52-calibre gun and RDM 155mm projectile.

Netherlands Receives New CH-47F

(gwh) The Netherlands has taken delivery of the first CH-47F MYII Common Avionics Architecture System (CAAS). In 2015, the country decided to replace 11 CH-47Ds, upgrade six CH-47Fs to the MYII CAAS standard and procure three new aircraft.

The new CH-47F corresponds to the US Army's standard version with a modern cockpit and precise navigation aids. The communication equipment enables constant data exchange for up-to-date and accurate situational awareness. The new maintenance system also detects signs of wear at an early stage. The Netherlands added a self-protection package with a missile warning and infrared suppression system, crash-proof seats in the cockpit and a Very High Frequency (VHF) radio for secure communication with Dutch units. The aircraft will also be equipped with a fast rope system for the deployment of special forces. Delivery of the 19 other aircraft is expected to be complete by mid-2022.

Photo: Defensie

Italy Searching for New Combat Vehicles

(gwh) Italy and Germany are considering cooperation on future combat vehicles. The Italian Army is looking for a successor to the DARDO IFV, which has been in service for 40 years. The same applies to the ARIETE MBT, which is almost as old. No replacement has been planned for either vehicle and Italian industry does not seem to have a solution that can be implemented within an acceptable period of time. For some time, talks between Germany and Italy have been held at government levels to find ways for Italy to participate in European combat vehicle programmes. Following talks between the Italian Defence Minister Lorenzo Guerini in Berlin and a visit to Rome by Armin Papperger, Chairman of the Executive Board of Rheinmetall, the procurement of LYNX IFVs for the Italian Army has emerged as a first approach, according to reports by the Italian magazine Analisi Difesa. According to these plans, Italy could acquire 400 to 600 LYNXs between 2025 and 2035, with a business volume estimated at around €2Bn, with Italy claiming a work share in the order of 70 per cent. This would mean, among other things, components from Italian production could be integrated with the turret. On the Italian side, Leonardo, Iveco Defence Vehicles and Rheinmetall Italia, could be considered for this.

Photo: Rheinmetall

Rubin Promotes BOSS Concept

(Sergey Kirshin) The Rubin Central Design Bureau for Marine Engineering has developed the first Russian submersible patrol ship intended for foreign customers. The project has been named STRAZH (SENTRY), but it will be marketed internationally under the Border and Offshore

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Photo: Rubin

Submersible Sentry (BOSS) designation. The concept reportedly combines the advantages of a submarine and a surface patrol ship.
The ability to dive provides the vessel with the advantage of discreetly observing suspects while avoiding harsh weather conditions without aborting the mission. A submersible ship can be used as a conventional submarine for intelligence, surveillance & reconnaissance operations as well as other missions. These include the seabed research capability (greater than that of a surface ship) and acting as an inexpensive training vessel to give crews seagoing experience. BOSS can also help prepare the infrastructure before a country purchases submarines at a later stage.

NATO Common Operational Picture Software Update

(wge) NATO is having the NATO Common Operational Picture (NCOP) software package updated and expanded. NCOP provides commanders with a common situation picture for their respective area of interest. It is intended to improve the planning, coordination and command of operations and missions. With real-time information from the theatre of operation, NCOP supports improved situational awareness and provides essential decision support. On 17 March 2021, Thales was contracted to deliver and install the 2nd increment of the software.

Photo: Thales

In joint operations, the forces generate a large amount of geo-referenced information that needs to be collected, correlated and aggregated so that it is available in a comprehensive situation picture. The Common Operational Picture (COP) thus generated ensures that the forces involved have a common view of the location, activities and objectives of the deployed units.
Thales was already contracted in 2012 to deliver Increment 1 of the NCOP software. The software is based on an open architecture, is modular and follows commercial and military standards. Increment 2 updates this system, which has already been used since 2015 in NATO command posts, both in static and deployable headquarters. It is also in use in the national command staffs of France, Poland and Italy.
With the expansion, Thales is implementing additional functionalities such as time management, event correlation and a strategic analysis capability.

Fourth MMF MRTT Delivered

(gwh) The OCCAR procurement organisation has taken delivery of the fourth of a total of nine Airbus A330 MRTT aircraft for the Multinational MRTT Fleet (MMF). OCCAR has ordered the aircraft on behalf of NATO in several tranches since 2016.
Despite poor weather during the takeover process and COVID-19 conditions, the aircraft was accepted according to schedule and handed over to the NATO Support and Procurement Agency (NSPA) for operation by the MMF.

Photo: NSPA

The first three aircraft were delivered between June and November 2020. The Multinational Multirole Tanker Transport Unit (MMU) operates the aircraft from Eindhoven (NL) and Cologne (DE) for training purposes and for use in operational tasks. Delivery of the fifth aircraft is scheduled for August this year with the last expected at the end of 2024.
The entire fleet will consist of nine multi-role tanker aircraft capable of providing strategic transport, aerial refuelling and medical evacuation capabilities to the six participating nations (Belgium, Czech Republic, Germany, Luxembourg, the Netherlands and Norway). The aircraft are owned by NATO and managed by NSPA with support from OCCAR-EA in the procurement phase and initial in-service support.
The aircraft's self-protection equipment includes defence systems against the threat of infrared-guided missiles. Back in 2017, OCCAR contracted the Israeli manufacturer Elbit Systems to supply infrared-based Passive Airborne Warning Systems (PAWS IR) and Direct Infrared Countermeasures (DIRCM). The J-MUSIC system used for this purpose is lightweight is designed with an open architecture that integrates laser technology together with a high frame rate thermal imaging camera and a small, high-speed dynamic turret.
Recently, the delivery order to Elbit has been extended to include the ninth A330 MRTT. The ninth tanker/transport aircraft had been ordered in 2020 after Luxembourg had widened its participation. OCCAR's framework agreement includes an option for two more aircraft.

Jet-Powered Flight Suit Tested

(gwh) The Dutch Korps Mariniers tested Gravity Industries' Jet Suit, which allows a person to move freely in the air. The tests were triggered by the demand to find new ways to conduct boarding operations.
The Jet Suit weighs 27 kg, consists of a harness with a jet-engine attached to the back and a twin jet-engine attached to each of the two forearms with a combined power of 800 kW. It is controlled by a handle and the position of the arms and legs. A flight can last between five and ten minutes. The top speed is 50 km/h. The flight altitude is limited to 3.7 km. The procurement price for civilian versions is in the mid six-digit euro range.
The Jet Suit can be used to reach locations that are otherwise practically inaccessible or can only be reached with great effort. This includes overcoming bodies of water, swamps, scree or rubble surfaces and artificial horizontal and vertical obstacles. Tactical tasks are, for example, overcoming minefields, walls and boarding ships. The suit could also help rescue services to quickly reach the scene in difficult environments (e.g. floods).
The high-risk tests focussed on flights close to the ground. Short routes initially served to find balance and achieve stable flight operations. This was followed by mission-like routes and tasks where the limits for practi-

Photo: Defensie

cal flight operations were flown. Flights at higher altitudes with increasing danger were rarely necessary for tactical reasons.
The special forces are now evaluating the trials and assessing what added value can be achieved with the Jet Suit. Then rules of engagement (Tactics, Techniques, and Procedures, TTP) are to be worked out before a marine is "flying" into action for the first time.

Germany Approves EURODRONE Budget

(gwh) The Bundeswehr is ready participate in the project for the development and procurement of the EURODRONE after the German Parliament's Defence and Budget Committees considered the corresponding €25M bill and released budget funds amounting to €3.1Bn on 14 April 2021.
Germany, France, Italy and Spain want to jointly develop and build the EURODRONE MALE RPAS. The system will rely on European technology. By the early 2030s, the EURODRONE UAS will be assigned the Bundeswehr's reconnaissance tasks that have so far been carried out by leased HERON 1 and HERON TP aircraft. The drone weighs around 11 tonnes (maximum take-off weight), is powered by two turboprop engines and is designed to operate for more than 24 hours. With a length of 16.4m and a wingspan of 30m, the aircraft can carry a payload of 2.3 tonnes (electro-optical, infrared and radar sensors, SIGINT and communication equipment and, as an option, weapons) at operates an altitude of up to 13,500m. The aircraft will fly at a speed of about 500 km/h.
As soon as the other nations involved in the PESCO project have completed their national approval processes, OCCAR will be able to conclude the contract with the industrial consortium led by Airbus Defence and Space. The consortium includes Dassault from France and Leonardo from Italy while a Spanish value-added share will be implemented through Airbus. The contract is to cover the development of the EURODRONE, the production of 60 aircraft and 40 ground stations (cockpits on the ground) and operational support for the first five years. Germany will receive 21 aircraft, France eight, Italy 16 and Spain 15.
As a European in-house development, the EURODRONE is expected to provide precise reconnaissance results for national and alliance defence, but also in crisis prevention and crisis response missions.


Photo: Bundeswehr

Franco-German Airlift Cooperation

(wge) The German Armed Forces intend to rely to a large extent on their French counterparts for the logistics support of the joint fleet of C-130J SUPER HERCULES transport aircraft. After the Bundestag committees gave the green light for this on 24 March 2021, funding is now available for a corresponding agreement with France.


Photo: Bundeswehr

The envisaged logistic support agreement (Technical Agreement Initial In-Service Support – TA IISS) includes the spare parts requirements,

equipment components and ground service equipment as well as initial industrial support services necessary for the joint operation of the Franco-German airlift wing. The agreement has initially been concluded to cover the period from 2021 to 2024. However, logistic support for regular operations (In-Service Support – ISS) is to be built on this in the future.

France will also secure the initial spare parts requirements and the initial industrial support from Lockheed Martin as the manufacturer via Foreign Military Sale (FMS) contracts with the US Government. The procurement of equipment components and ground service equipment is also to be carried out by France with the objective of achieving operational and logistic uniformity. This will also serve to cover the requirements of the German aircraft.

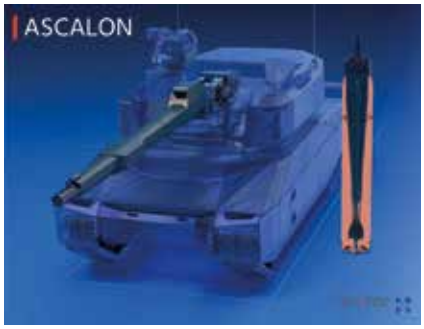
Until now, these service components for initial in-service support for the first three years have been part of the FMS procurement contract with the US. The volume of the contract for six aircraft amounts to €965M. Since the scope of services specified in the agreement with France is already largely covered by this procurement contract, it is intended to separate these parts from it. In order to cover the higher demand for spare parts calculated in the agreement, this will lead to an additional financial requirement of approximately €50m over the term of the agreement.

The above-mentioned additional requirement is justified by the first French experiences , based on which it was realised that the calculations in this regard were too optimistic when the original offer was made. The agreement with France is based on a requirement of 600 flight hours per aircraft per year. The application of uniform French logistic procedures and processes is also expected to reduce expenses here.

ASCALON Proposed for MGCS

(gwh) Nexter has presented its armament concept for the Main Ground Combat System (MGCS). As high-intensity confrontations are expected to return in the coming decades, the MGCS and comparable systems will also need a large-calibre gun as their main armament. Based on the experience with the 120 mm smoothbore gun with automatic loader of the LECLERC MBT and its own ammunition development (including telescopic ammunition) Nexter has developed the Autoloaded and SCALable Outperforming guN (ASCALON) concept. This is intended to improve the chances of winning the fight from the outset by shooting and hitting faster, further and with a higher destructive effect of the first shot.

Photo: Nexter



At the same time, logistic and ergonomic constraints will be reduced.

ASCALON Features

According to Nexter, ASCALON offers an open architecture that will serve as the basis for joint development within the MGCS programme. This concept, it says, lays the foundation for the future European MBT gun and ammunition standard, drawing on previous experiences with allies, such as the 140mm Future Tank Main Armament gun programme in the 1990s. Participants at that time were Germany, France, the UK and the USA.

Nexter lists five distinguishing features of the main armament system:

- Extended ammunition range taking advantage of the larger calibre. Penetrators of different lengths allow adaptation to the target spectrum. Guided ammunition allows engaging targets beyond the line of sight and Non-Line of Sight (NLOS).
- Compact ammunition with a maximum length of 130 cm. Telescopic ammunition with the bullet completely inside the cartridge case.
- Increased firepower thanks to an optimised loading chamber. With an almost unchanged internal pressure level, up to ten megajoules are available at the muzzle, with growth potential for up to 13 megajoules.
- Controlled pressure curve and newly designed muzzle brake reduce undesirable pressure effects on the vicinity. This reduces the danger to infantrymen in joint combat, especially in urban environments.
- The controlled impulse on firing reduces recoil and acceleration forces. This allows the system to be integrated with platforms weighing less than 50 tonnes.
- Next Steps

In firing campaigns with telescopic ammunition and a 140 mm smoothbore gun, the mastery of the system could be demonstrated and its high technical maturity proven. The system is expected to be fully technically mature by 2025. At the end of 2022, the MGCS project will decide which main weapon will be selected for the programme. The technology demonstration phase is to be completed by 2024.

In March 2021, Rheinmetall presented its concept for the main weapon system of the MGCS based on a 130 mm smoothbore gun, arguing the calibre is not decisive for the effectiveness of the concept. Instead, it pointed out that the charge volume and the muzzle energy that can be achieved with it are. Rheinmetall is also applying for the technology demonstration phase of the MGCS.

Russian Exercises with MIG-31BM

(Yury Laskin) Russia is conducting a large number of military exercises, a notable aspect of which is the deployment of MiG-31BM interceptors near Anadyr, on the Chukotka peninsula. Since the end of last year, these aircraft have been constantly on duty not only in Chukotka, but also on the Novaya Zemlya archipelago. Satellite images released in early April showed the presence of several interceptors and military transport aircraft.

Photo: MoD Russia

A series of major exercises already happened in the Russian Arctics during March, the most important of which was UMKA 2021 (a Russian nickname for a polar bear cub). The drills involved nuclear submarines, various aircraft, as well as arctic motorised riflemen. This took place near the Franz Josef Land archipelago, where the Trilistnik (Trefoil) military base and the Nagurskaya airfield (both year-round) were established. Arctic motorised riflemen were also transferred to the exercise area. The troopers set up a field camp to conclude combat training over the terrain under temperatures below minus 30 Celsius.

The military exercises were carried out with the Russian Geographical Society participation which was engaged in research activities. The Russian MoD intends to continue this practice in future for a better investigation of the Russian Arctics.

The MiG-31s are to be extensively upgraded with the United Aircraft Corporation contracted to convert all existing 110 MiG-31s to the BM version. The programme is well

underway and scheduled to be completed by 2023. The intention is to extend the life of the aircraft until at least 2030s.

New OMFV Teaming Agreement

(gwh) The "Team Lynx", led by American Rheinmetall Vehicles for the offer and subsequent production of variants of the LYNX KF41 IFV to replace some 4,000 BRADLEYs operated by the US Army, has been strengthened by a cooperation agreement with L3Harris. The vehicle is competing in the US Army's project for the development and production of an Optionally Manned Fighting Vehicle (OMFV).

Currently, the Army Futures Command is developing the military requirements with inputs from industry. Following a call for tenders, five applicants will be selected in the middle of the year to deliver a digital design of the future combat vehicle within 15 months.

To improve its chances in the competition, Rheinmetall is setting up "Team Lynx", which includes companies from the USA in the project. So far, the US Industry Team includes Raytheon Technologies and Textron Systems, among other US defence companies. L3Harris, a specialist in vehicle mission systems and cyber security solutions, has now joined the team to implement the LYNX's Modular Open System Architecture (MOSA).

Photo: Rheinmetall

MOSA allows parts and subsystems to be common across platforms and domains to enable easy and cost-effective upgrades. The design approach incorporates proven technologies and lessons learned from the L3Harris programmes and activities around the US Army's efforts towards modular, open systems architectures for air and land platforms.

The LYNX KF41 IFV is beginning to make its mark on the defence market. In 2020, Hungary became the first country to order 218 vehicles, with delivery of the first 46 vehicles by early 2023. In Australia, the LYNX KF41 is among two vehicles selected to undergo selection testing by the end of 2021. As part of the LAND 400 Phase 3 project, up to 450 vehicles of various configurations are to be procured. In the Czech Republic, 200 IFVs are to be procured with a decision promised for the beginning of 2021 still pending. In Slovakia, the LYNX has been presented as the first vehicle in the market review. By the end of 2021, the selection for the procurement of around 50 IFVs is expected.

URAN-9 UGVs for the Russian Army

(Yuri Laskin) The first unit equipped with strike robots is to be formed by the Russian Army, Defence Minister Sergei Shoigu told reporters during his visit to the 766 UPTK Production and Technology Company. According to Russian media, an experimental unit will be equipped with five URAN-9 systems, each consisting of four UGVs and a mobile command station. The 776 UPTK officials announced the delivery of a new batch of 20 URAN-9 armed UGVs to the Russian Army for the near future.

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In addition to URAN-9, 766 UPTK has also developed and supplied the Russian Army with URAN-6 mine-clearing robots and URAN-14 robotic fire-fighting systems. URAN-6 was employed in Syria and is currently operated by the engineering units of Russia's peacekeeping contingent in Nagorno-Karabakh.
The URAN-9 tracked armed UGV was unveiled in September 2016 during the ARMY-2016 exhibition in Russia. It completed acceptance trials in 2020.
URAN-9 is designed to provide remote reconnaissance and fire support to combined combat, reconnaissance and counter-terrorism units. It can be used fully autonomously on a predefined road or manually operated by one man from a control station located either in a truck or in a backpack. The UGV can be fitted with different weapons depending on the mission profile. Options include four ATAKA anti-tank guided missiles and IGLA or VERBA surface-to-air missiles, or KORNET ATGM.

Photo: Yuri Laskin

URAN-9 is also armed with a 30-mm automatic cannon and six ready-to-launch SHMEL reactive flame launchers. There are two ATAKA missile launchers and three SHMEL launchers on each side of the turret. URAN-9 is powered by a diesel-electric engine providing maximum speed of 35 km/h on roads, slowed down to 10 km/h in off-road conditions.

Lightweight Bullet-Proof Jackets for the Indian Army

(Suman Sharma) The Indian Army will now be able to operate with lightweight bullet proof jackets indigenously developed by India's premier defence research agency DRDO (Defence Research and Development Organisation). These jackets were launched in 2017 and are now ready for use.
These lightweight jackets developed by the Kanpur-based DRDO laboratory DMSRDE

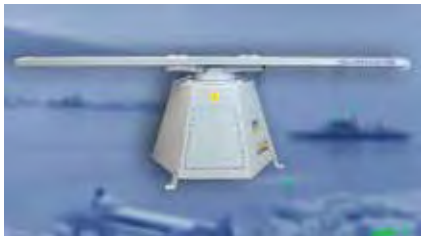
Photo: DRDO

(Defence Materials and Stores Research and Development Establishment), weigh nine kilogrammes, and meet the qualitative requirements of the Indian Army. The front hard armour panel (FHAP) jacket was tested at Chandigarh-based TBRL (Terminal Ballistics Research Laboratory) and met relevant BIS (Bureau of Indian Standards) standards. The importance of this vital development lies in the fact that each gram of the bullet proof jacket weight reduction is crucial in enhancing soldier comfort while ensuring the survivability. This technology reduces the weight of the medium sized jacket from 10.4 to 9 kilogrammes.
Defence Minister Rajnath Singh, while congratulating the team, called it a significant step towards Self-Reliance.

Hensoldt UK Radars for Polish Navy

(jr) Hensoldt UK is to deliver Kelvin Hughes Mk11 X Band SharpEye navigation radars for two Polish Navy KORMORAN II class minehunters, ORP ALBATROS and ORP MEWA. Installed in conjunction with an OSI Maritime Systems integrated navigation bridge system, the radars will be tasked with navigation and surface surveillance functionality, providing the Polish Navy with solid state radar sensors to ensure safety of navigation whilst providing advanced small target search capability. The Polish Navy now joins more than 30 navies worldwide using Kelvin Hughes SharpEye radar sensors.

Photo: euro-sd.com



Revision Introduces The Honor Collection

(jr) New offerings from Revision Military include "The Honor Collection" – a product category where 20 per cent of the proceeds from each purchase is donated directly to a select military or law enforcement charity.
The first offering of The Honor Collection is a special law enforcement edition StingerHawk® spectacle, featuring a blue line-branded frame and corresponding microfibre storage pouch. Proceeds will benefit Concerns of Police Survivors (C.O.P.S.), a non-profit organisation providing resources to help the families and co-workers of officers killed in the line of duty. This also offers training and assistance to law enforcement agencies nationwide on responding to the tragic loss of a member of the law enforcement profession.
In response to an imminent demand for laser protection, Revision has delivered several thousand ballistic laser protective lenses to law enforcement around the US. After an initial delivery to the Department of Homeland Security, Revision received an increased number of inquiries from federal, state and local departments.

Photo: Revision

Since last summer, reported incidents of laser attacks on law enforcement have significantly grown in the US leading to a variety of eye effects and injuries, including reports of partial blindness. While handheld lasers are not new, their widespread use with intent to harm is increasing.
The Honor Collection is available at the company's website revisionmilitary.com and StingerHawk LE Edition kits are priced with special introductory offer.
All products exceed military-spec ballistic standards, offer OcuMax anti-fog performance and an optional integrated prescription correction solution.

Bittium Tactical Management Suite Launched

(jr) Bittium has launched its advanced Bittium Tactical Management Suite to enable secure management of the company's tactical communication devices and networks prior, during and after deployment.
Bittium Tactical Device Management is a system that enables secure deployment and operative use for the tactical communication devices. With the system, different defence forces can maintain sovereign, centralised control over Bittium's tactical devices. The system enables preparation of the devices for operative use, including commissioning, software updates and key management. After the devices have been deployed, the sys-

Photo: Bittium

tem operator can monitor and manage the devices remotely over a secure connection.
Bittium Tactical Network Management is a visual system for managing Bittium's tactical communication networks and network nodes, including Bittium Tactical Wireless IP Network™, Bittium Tough SDR™ and Bittium Tough Comnode™. Different defence forces can use the system's tools for planning the locations of the networks and their nodes so that optimal network performance can be achieved. When the networks are in operative use, the system provides a real-time status view of network operation and node configurations. The data collected from the networks and nodes during operative use is recorded for subsequent analysis. This enables optimising the network performance for upcoming operations.

Babcock Awarded MCG Contract

(jr) Babcock International and BAE Systems have been awarded a five year contract extension by the UK Ministry of Defence to continue in-service support for the Royal Navy's 4.5 Mk8 Medium Calibre Gun (MCG).
The agreement is worth c. £43M and will see the continuation of in-service support to the 4.5 MCG across 19 Type 23 Frigates and Type 45 Destroyers as well as HMS COLLINGWOOD. The continued collaboration between Babcock and BAE Systems as the gun's designer offers the capacity, capabilities and infrastructure to run in-service support. Babcock has also opted to implement innovative DIGITAL TWIN technology to drive an increase in reliability and availability of the weapons system and work to extend its service life. The effort to increase efficiency will also see the roll out of BAE Systems' design interventions.
DIGITAL TWIN enables digital connection with the asset presenting near real time insight to the materiel state of the gun. It combines Babcock proprietary data capture technology and data science capability. The technology provides the on-board maintainer with the information they need to optimise maintenance and provides Babcock the foresight needed to predict future faults and proactively intervene to keep the asset operational and increase availability. The Mk8 MCG is a semi-automatic variant and can rapidly fire high explosive rounds against land and sea targets.

Photo: Babcock

DLR Chooses iSpace for Earth Orbit Observation

(gwh) The German Space Agency at the German Aerospace Centre (DLR) has selected Lockheed Martin's iSpace command & control system to monitor objects in Earth orbit. iSpace is capable of monitoring more than 300,000 objects in Earth orbit in real time from data collected by a worldwide network of government, commercial and scientific radar systems.
The domain of has changed from a formerly secure environment to one that is congested and threatened. A growing number of satellite-system owners and operators therefore require new capabilities to protect their systems and protect their interests in space. This concerns in particular events such as collisions, manoeuvres, launches, aborts and other threats in orbits.
DLR Space Management operates the German Space Situational Awareness Centre (GSSAC) in Uedem alongside the German Air Force. Here, iSpace interfaces with the German Experimental Space Surveillance and Tracking Radar (GESTRA) space surveillance radar, which was established in Kob-

Photo: Lockheed Martin

lenz on 13 October 2020. The iSpace system is used for:

- Situational awareness
- Acquiring orbital data of satellites and debris in near-Earth space
- Analysing anomalies and issuing recommendations for action

iSpace has been in use since 2017 and has been deployed as part of several US Strategic Command Global Sentinel exercises. This forum aims at an improved collaboration on space situational awareness. In addition to Germany, partner nations include Australia, Canada, France, Italy, Japan, South Korea, Spain and the UK.

Upgraded MBTs for Ukraine

(gwh) The Ukrainian Army received five upgraded T-64 and T-72 MBTs at the beginning of April. In the first quarter of 2021, 10 MBTs of these types were already handed over to the troops. Equipping the Ukrainian Armed Forces with modern, high-performance equipment is particularly important in view of current security policy developments.
At the Lviv Armoured Plant (LBTZ), which belongs to the Ukrainian arms holding company Ukroboronprom, the tanks have been equipped with:

- Modern fire control systems
- Internal and external communication equipment
- Day and night vision devices
- Rear-view cameras
- Satellite navigation
- Dynamic protection.

Photo: Ukroboronprom

Despite limited funds, the tanks were handed over before the agreed delivery date.
The T-64 has been built since the 1960s and has been modernised time and again. Its hallmarks are the 125-mm main gun with automatic loader and the composite armour – recently supplemented by reactive armour. The T-72 is considered as a further development of the T-64, which should overcome its technical difficulties. Around 17,000 T-72s have been produced since 1972 and have been exported worldwide.

Russia & Vietnam Discuss Increased Defence Cooperation

(Yuri Laskin) Russian Security Council Secretary Nikolai Patrushev and the Chief of the General Staff of the Vietnamese People's Army Phan Van Giang recently discussed strengthening ties between the two nations in the field of defence and military-technical cooperation.
The meeting between the Russian and Vietnamese officials took place in Hanoi as part of

Photo: UAC

Patrushev's two-day working visit to Vietnam. Security Council Press Secretary Yevgeny Anoshin, said, "The parties stressed that defence and military-technical cooperation are the key components of the comprehensive strategic partnership between Russia and Vietnam being of a trusting and advanced nature."

According to open sources, Russia has supplied Vietnam with:

- Four GEPARD class frigates
- Six Project 636 VARSHAVYANKA conventional submarines
- 12 MOLNIYA missile boats (two of which were delivered ready-made from Russia with 10 produced under licence in Vietnam).

The Vietnamese Navy is also equipped with the BASTION mobile coastal missile system which employs YAKHONT anti-ship missile.

Russian-made air defence systems form a core of Vietnam's national air defence which includes a large number of S-300PMU1 long range systems and IGLA MANPADS. The Vietnamese Air Force operate 32 Su-30MK2 multirole fighters and in 2019, Vietnam and Russia reportedly signed a deal for at least 12 YAK-130 combat trainers for over US$350M.

In September 2019 Alexander Mikheev, Rosoboronexport CEO announced that Vietnam had become one of the largest customers for Russian military products.

At the time, he said, "Today Vietnam is one of the key partners of Russia in Southeast Asia. Cooperation between our countries is going on in all types of weapons and military equipment. As part of the modernisation of the national armed forces, Vietnam has become one of the largest customers for Russian products, and we note with satisfaction that despite the growing competition, our samples are still a priority here."

TESAT Technology Chosen for Key Programme

(jr) TESAT is continuing its success story for broadband laser communication in space. The development that ranges back to the laying of the cornerstone within the US NFIRE and TerraSar-X success in 2008, where TESAT first proved the functionality and capability of optical inter-satellite links in low Earth orbit (LEO), comes now to full bloom.

With the recent contract between Lockheed Martin Space and TESAT for the Space Development Agency's Transport Layer Tranche 0 programme, the long-term partnership between the two companies continues. TESAT will provide the ConLCT80, a Laser Communication Terminal (LCT) dedicated for the broadband LEO constellation market. The ConLCT80 is a miniaturisation of the well-known heritage LCT135, which is flying currently on nine satellites, performing 1,000 optical inter-satellite links (OISL) monthly, more than 51,000 in total by now.

Further ALTIUS UAV Progress

(Yuri Laskin) Russia's new ALTIUS-RU Medium Altitude Long Endurance (MALE) UAV has become the first indigenous UAV to incorporate the on-board function of transmitting control commands to the UAV, and reconnaissance data from the UAV to the ground, via a satellite communication channel. This was announced on 27 March 2021 by the chief designer of the project, Ilya Matveev.

Photo: http://bastion-karpenko.ru/index/

"This onboard satellite communication channel was developed in Russia particularly for integration into our UAV. Our drone is the first to be equipped with this kind of radio communication capabilities," he said. "The satellite receiver is located under the UAV's nose fairing."

Russian media reported that this is the final version of the ALTIUS-RU UAV, following the development and testing of a number of prototypes.

Russia has been developing the ALTIUS UAV since 2011 and in 2018, the project was transferred to the Kazan division of the Ural Civil Aviation Plant (UZGA). The Russian Ministry of Defence has signed a contract with UZGA to produce the initial batch of ALTIUS-RU UAVs. UZGA is experienced in drone production, as it manufactured the IAI SEARCHER under license and renamed it FORPOST, after which it localised and upgraded it to the FORPOST-R option.

ALTIUS has a wingspan of under 30m and is propelled by two 500 hp VK-800C turboprop engines developed by the Klimov Design Bureau. It can climb to a height of 14km with flight autonomy of up to 48 hours and an empty weight of six tons. The drone can carry a 2t combat payload over a combat range of about 3,500km.

The fixed-wing design of the UAV incorporates a large high-mounted wing, a V-tail configuration and a three-leg retractable landing gear. The flight, including the take-off and landing stages, can be performed automatically. ALTIUS is expected to perform reconnaissance, strike and electronic attack missions for the Russian Air Force and Navy.

ALTIUS will also have artificial intelligence elements to interact with Sukhoi Su-57 fighter jets. It will lay routes to bypass air defence without human interference, find and attack important targets (headquarters, communication hubs, missile launchers) and return to the base.

Joint NNbS Air Defence System Bid

(jr) Rheinmetall Electronics GmbH, Diehl Defence GmbH & Co. KG and Hensoldt Sensors GmbH have signed an agreement to cooperate in a special partnership known as an "Arbeitsgemeinschaft", or ARGE. Under the framework of ARGE NNbS, the three companies will submit a tender for the future German close- and short-range air defence system. NNbS is the German abbreviation for "Close- and Short-Range Protection" (Nah- und Nächstbereichsschutz).

The NNbS project is to bridge a current capability gap when it comes to protecting ground troops during deployed operations, as well as securing tactical operation centres and other assets against short-and very short-range aerial threats.

The three companies aim to provide a national, low-risk solution, that will be quickly available thanks to the use of commercially available systems and system components.

Photo: Rheinmetall

The conceptual system design of ARGE NNbS relies primarily on proven systems and subsystems, including integration of components already in use by the Bundeswehr and providing related logistic support.

Third F125 Class Frigate Delivered

(jr) Thyssenkrupp Marine Systems (TKMS) has handed over the frigate SACHSEN-ANHALT to the Federal Office of Bundeswehr Equipment, Information Technology and

In-Service Support (BAAINBw). It is the third of a total of four ships of the class F125 which TKMS is building in the ARGE F125 consortium together with the Fr. Lürssen Shipyard.
The ceremony in Wilhelmshaven was low profile due to the pandemic. On behalf of tkMS, Programme Manager Patrick Buggenthin signed the handover papers. The last ship of the four units, RHEINLAND-Pfalz, is to be handed over later this year.


Photo: euro-sd.com

The F125 class frigates feature a variety of highly complex systems and around 28,000 sensors that enable a very high degree of automation, making it possible to reduce the required number of crew members by about half compared to previous frigate classes. The ships can remain in the theatre of operation for up to two years. Besides the traditional tasks of national and alliance defence, they are designed for conflict prevention and crisis management as well as for intervention and stabilisation operations in an international context. In addition to the ability to engage targets both on land and at sea, they are equipped with air defence systems and helicopters.
The contract for the construction of the four frigates became effective in June 2007. The concept, design and detailed design phases followed. Around 90 per cent of the highly complex systems on board the F125 were developed specifically for this new type of ship.
The pre-fitted bow sections were produced at the shipyards of the Lürssen Group in Bremen and in Wolgast on the Baltic Sea. Construction of the stern sections, the joining of the two vessel halves, further fitting-out, commissioning and testing all took place at the Lürssen location of Blohm+Voss in Hamburg.

New MELLS Order for Rheinmetall

(jr) The German Bundeswehr has placed a new order for the MELLS anti-tank guided missile system with EuroSpike GmbH. MELLS (Mehrrollenfähiges Leichtes Lenkflugkörper-System) is the German acronym for Multi-Role Light Guided Missile System. The order has a value of around €88M. Under the terms of the contract, Rheinmetall will be supplying key components. Delivery will take place during the 2022-2024 timeframe.
As the fourth batch of MELLS missiles ordered by the Bundeswehr, the systems are earmarked for German infantry and mechanised infantry units. Rheinmetall will be supplying 82 integrated command and launch units as well as 666 sets of components for the Rafael-made SPIKE Long-Range (LR) guided missile. The latest version of the launch system is already capable of firing the enhanced SPIKE LR 2 guided missile.
Concluded in October 2019, the framework contract includes an option for the production and delivery of around 100 integrated command and launch units as well as thousands of MELLS missiles from 2024 to 2031, thus a total contract volume in the three-digit million-euro range for Rheinmetall.
Made by EuroSpike –a joint venture of Rheinmetall, Diehl and Rafael – the MELLS is a new generation ATGM designed for engaging armoured ground targets at ranges of up to 4,000 metres, or 5,500 metres with SPIKE LR-2. Rheinmetall has already integrated the missile system with the MARDER IFV and is currently doing so with the Puma IFV. FFG Flensburger Fahrzeugbau is integrating the system with the WIESEL airmobile weapon carrier.


Photo: Rheinmetall

GRAY EAGLE Marks One Million Flight Hours

(jr) General Atomics Aeronautical Systems, Inc. (GA-ASI) has announced that its family of GRAY EAGLE Unmanned Aerial Systems (UAS) surpassed one million flight hours in March 2021 during US Army flight operations.
This historic milestone is the latest accomplishment on a journey that started in March 2004 with the first flight of an early variant of the GRAY EAGLE UAS family called Army IGNAT. Since that first flight, GA-ASI and the US Army have fielded over 250 GRAY EAGLE type aircraft, including the new GRAY EAGLE Extended Range (GE-ER) aircraft. Over 80 per cent of the one million flight hours were flown in support of deployed operations with a better than 90 per cent mission capable rate.


Photo: euro-sd.com

The GE-ER UAS is a 40-hour endurance aircraft with increased payload capacity, reliability and maintainability over the legacy MQ-1C GRAY EAGLE first fielded in 2009. On the dawn of the next million flight hours, GE-ER is being further enhanced under the US Army's modernisation programme to incorporate new technology for standoff survivability, while expanding the payload capabilities to include Air Launched Effects (ALEs) and long-range sensors for stand-in effects. This MDO-ready UAS will be powered by a new 200-hp enhanced heavy fuel engine and dual 7.5kw brushless generators.

SKELDAR Taking Part in Detect & Avoid Project

(jr) After the SKELDAR V-200 UAV was selected to be part of a new European Commission (EC) programme in December 2020, the EC awarded a contract to the European Detect and Avoid System (EUDAAS) consortium – of which Saab is leading partner – to develop and validate a European Detect and Avoid (DAA) solution for safe insertion of large military Remotely-Piloted Aircraft Systems (RPAS) in European air traffic.
The DAA system is to provide the remote pilot with the ability to "see and avoid", including a fully automatic collision avoidance function which will initiate manoeuvres to avoid collision with other aircraft if necessary. The system will be tested on several unmanned platforms, with UMS SKELDAR providing the V-200 for tests in Sweden. While the focus of the project is on military unmanned aircraft, the technology is applicable to civil systems and will be fully compliant with civil requirements. The programme will run for three years and work closely with civil developments in the field such as regulatory development with the European Aviation Safety Agency (EASA) and will contribute to standardisation within the European Organization for Civil Aviation Equipment (EUROCAE).


Photo: Kredo Consulting

Polish-Romanian Defence and Security Policy

Eugene Kogan

Poland and Romania are two of the most ardent supporters of the North Atlantic Alliance and spend 2% of their GDP on defence. The two countries are eye-to-eye vis-à-vis Russia as their adversary, although they are based in the Baltic Sea and Black Sea, respectively.

A joint initiative of Romanian President Klaus Iohannis and Polish President Andrzej Duda, known as the 'Bucharest Nine', was launched in November 2015 and laid a foundation for foreign and security policy meetings and discussions. As the next step, the Warsaw NATO Summit in July 2016 accelerated military-to-military cooperation. As a result, the initiative brought Romanian troops to Poland and Polish troops to Romania on a rotational basis in March 2017. In addition, their pivotal positions in the east and in the south of NATO's reach have further increased their cooperation in a variety of defence and security programmes.

Even though the first Romanian-Polish intergovernmental meeting took place in Warsaw on 25 May 2018, the cornerstone of this meeting was laid in Warsaw in July 2016. The participants in the 2018 Warsaw consultations agreed on strengthening bilateral cooperation in security and defence. During the visit of Pawel Soloch, the Head of the Polish National Security Bureau (BBN), to Bucharest on 27 February 2021, Romania's Foreign Minister Bogdan Aurescu, reiterated his country's interest in strengthening bilateral cooperation in security and defence. The participants in the Warsaw consultations also agreed to conclude a bilateral cooperation agreement in the defence industry in the near future. However, the coronavirus pandemic in 2020-21 has delayed the signing of the agreement.

Finally, a joint EU-NATO Military Mobility initiative that is likely to impact on the rail and road infrastructure of the two countries, among other things, and which was unveiled in March 2018 has come

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Photo: U.S. Army Photo by Staff Sgt. Brian Kohl

Romanian air defence soldiers pose for a photo during exercise SABER STRIKE 2017 at Bemowo Piskie Training Area, Poland.

Photo: MoD Poland

In June 2020, Poland,the US, the UK, Romania and Croatia conducted military exercises on NATO's eastern flank near the Suwalki Gap.

Photo: Presidential Office Romania

'The Bucharest Nine' (B9) format intends to promote cooperation on national security matters vis-à-vis Russia.

to a halt. For the time being, it can be renamed Military Mobility with Financial Deficiency. As usual, the lack of funds for a "flagship initiative" hampers progress.

'The Bucharest Nine'

'The Bucharest Nine' (B9) format was created in Bucharest in November 2015 on the initiative of the Romanian and Polish presidents. President Duda emphasised in his speech in Warsaw on 12 May 2020 that the "regional cooperation format like the B9 is a key instrument to bolster the security of the countries around the Baltic Sea, in Central Europe and in the Black Sea region." The B9 format brings together Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania and Slovakia. It has the potential to promote practical cooperation and regular consultation on national security matters. To date, this format has proven to be an arena for foreign and security policy meetings and discussions and less as a means for practical cooperation. However, the practical cooperation between the two countries on defence issues began shortly after the pivotal NATO Summit in Warsaw in July 2016.

Military Cooperation

Following the NATO Summit in Warsaw, the two countries agreed to host each other's military forces on a rotational basis. The robust military-to-military cooperation to ensure the security of NATO in Central and Eastern Europe and South-Eastern Europe has turned out to

be a first milestone in bilateral relations. Romania has deployed a GEPARD self-propelled air-defence artillery battery to Poland within the NATO Enhanced Forward Presence Battle Group, while Poland deploys troops of the 17th Greater Poland Mechanised Brigade to Romania within the Tailored Forward Presence, which is the Alliance's initiative in the Black Sea region. Their deployment started in March 2017. According to Ovidiu Dranga, Ambassador of Romania to Poland: "The soldiers of Romania and Poland are excellent ambassadors of both countries. Their presence is an expression of a mutual strategic commitment Romania and Poland have assumed. This arrangement is a real success story and we are exploring possibilities to enhance and enlarge it."

Although Ambassador Dranga did not elaborate further, the Head of BBN Soloch, during his visit to Ukraine in January 2020, proposed the formation of a Romanian-Polish-Ukrainian military cooperation. He said that he "Supported trilateral military ties in the form of the existing cooperation within the framework of the Lithuanian-Polish-Ukrainian brigade, LITPOLUKRBRIG." The proposed brigade, based on the experience and lessons learned of the LITPOLUKRBRIG that was formally established in January 2016, will be crucially important for the three countries involved. Soloch, however, added, "There was so far no fixed date for its inception." If, however, the proposed idea goes ahead, it will be the next milestone in the first trilateral cooperation, and it will further cement strategic relations between Poland, Romania and Ukraine.

Similar Weapon Systems

The two countries have so far separately acquired similar weapon systems without even considering joint consultations. The weapon systems include F-16 fighter aircraft, the PATRIOT Advanced Capability-3 (PAC-3) missile defence system, a High Mobility Artillery Rocket System (HIMARS) and a Naval Strike Missile (NSM). For instance, cooperation in training, operation, maintenance, upgrade and the production of spare parts for the F-16 by the two countries can be extended to Bulgaria and Slovakia which have recently acquired the F-16. As a result, the four countries will save enough funds to reinvest in their respective countries' defence industries and in the improvement of their rail and road infrastructure that is of crucial importance to the European Union (EU)-NATO proposed Military Mobility project.

The next step in the cooperation should include not only the joint procurement of armed helicopters and the Advanced Anti-Radiation Guided Missile (AARGM) anti-radiation missiles for F-16s, for instance, but also joint manufacturing and development projects. As for the missiles, they can be used in breaking the Anti-Access/Area Denial (A2/AD) systems belonging to an adversary.

It is still unknown whether Poland and Romania will join forces in R&D for the next generation main battle tank (MBT) together with Spain and Italy or South Korea. This, however, requires the two countries' presidents, prime ministers, ministers of defence and leaders of the defence industries to have a collective discussion and then decide if such a mutually agreed project goes ahead. Such a project may become a cornerstone of defence industry cooperation that may also include Bulgaria. It will also spur investments in R&D, provide expert service for marketing analysis and lead to joint manufacturing, sales efforts and the establishment of post-sales services.

Defence Industry Cooperation

Both countries have well-developed defence industries; for example, Poland's WB Electronics able to manufacture unmanned aerial vehicles (UAVs) currently operated by the Polish Armed Forces. The PGZ Group (Polish Armaments Group) has experience in designing and manufacturing its own tanks and upgrading the LEOPARD 2PL MBT, designing and manufacturing the infantry fighting vehicle (IFV) BORSUK and upgrading the Soviet-era BWP-1 (BMP-1) platform, as well as upgrading the Soviet-era Mi-24 helicopter. At the same time, Romania has a well-known aviation industry capable of manufacturing trainer aircraft, as well as maintaining and modernising Soviet-built fighter aircraft. Recently, it was announced that Aerostar Bacau will modernise and maintain F-16 fighters for the Romanian Air Force. The two industries also have fruitful cooperation with Israeli companies such as Elbit Systems, Israel Aerospace Industries and Rafael Advanced Defence Systems. However, it is unknown whether the defence industries of the three countries can join forces, but this is certainly not inconceivable.

It is clear though that the Romanian Ministry of National Defence (MoND) is interested in acquiring UAVs. The new competition is expected to attract bids from the US, Israel and Romania. Why not to invite WB Electronics? It was reported in December 2020 that Poland is interested in acquiring the GRYF medium-range tactical UAVs. The two countries' acquisition of the UAVs should encourage the Polish and Romanian defence industries to join forces.

As a result of this competition, Romaero and Avione Craiova, together with El-

Photo: MoD Romania

In March 2018, the Chief of the Romanian General Staff, General Nicolae Ciucă, met the Chief of the General Staff of the Polish Armed Forces, Lieutenant General Leszek Surawski, in Bucharest to discuss the security situation in the region.

bit Systems, signed a Memorandum of Agreement (MOA) for cooperation in manufacturing Elbit's UAVs in May 2020. The MOA states that Romanian companies will be liable for the assembly, integration, training, maintenance and repairs and programme management.

Attending the 3 September 2020 signing of the Memorandum of Understanding (MoU) between Romaero and the Lockheed Martin subsidiary, Sikorsky, for the establishment of a Central European Regional Centre for the Maintenance of BLACK HAWK helicopters in Romania, the US Ambassador in Bucharest, Adrian Zuckerman, said that the "Current cooperation between Lockheed Martin and Romaero is representative of the security partnership and extraordinary relations between the US, Romania and Poland."

In case Romania decides to acquire BLACK HAWK helicopters, they will be delivered by Romaero from the Poland-based PZL Mielec factory for their final assembly (the BLACK HAWK is already in service with the Polish Air Force).PZL Mielec is the largest production facility of Lockheed Martin in the EU.

Finally, the EU-NATO proposed project to improve the rail and road infrastructure for the nations on the EU and NATO's eastern flank is likely to bring many benefits to Poland and Romania and their military cooperation. However, much depends on the funding released for such a large project.

Military Mobility

In 2018, the EU Commission set out a plan to improve infrastructure and remove legal hurdles to allow for the faster movement of troops and vehicles across the continent, a vital security issue for nations on the EU and NATO's eastern flank. In March 2020, EU and NATO members Latvia, Lithuania, Poland and Romania argued that the European Commission's technical document on the EU's 2021-27 budget proposed reduced funding for the military mobility programme.

Throughout the negotiation process, the proposed funding for military mobility has declined from €6.5Bn in the initial EU Commission proposal to €2.5Bn under the Finnish Presidency negotiating box and to €1.5Bn under the EU Council President Charles Michel's proposal. According to the final document, the funding for the military mobility programme was kept at €1.5Bn; namely, just slightly under 25 percent of the initially proposed €6.5Bn. This sum is undoubtedly not sufficient for improving infrastructure for the so-called joint EU-NATO "flagship initiative." Whether the European Commission will provide extra funds for the initiative remains unknown.

Conclusion

Bilateral military cooperation remains the cornerstone of the two countries relations' for the time being. The joint procurement and manufacturing of weapon systems, as well as a joint effort in R&D can be the next step in their bilateral cooperation. For such an initiative to succeed, the relevant political and defence industry stakeholders in both countries must seize the opportunity and turn political will into industrial deeds. It can be recalled that the two countries possess well-developed defence industries able to succeed in this endeavour. Poland and Romania also have high-skilled labour and funds to invest in R&D to promote their military goods globally. What the author proposes is not inconceivable, but it is doable. Another option for the two countries' joint development is linking their efforts in the defence industry field with Israeli companies. This trilateral cooperation will lead to a healthy competition for the EU and NATO defence markets. As for the future of the B9, the judgement is still pending. However, one thing is for sure - turning meetings and discussions into practical cooperation is a must for the B9. Finally, military mobility with reduced funds turns a "flagship initiative" into military immobility.

A New Global Strategic Vision or a Fantasy?

Reflections on the British Integrated Review of Security, Defence, Development and Foreign Policy

David Saw

In March, the British Government published a critical document entitled "Global Britain in a Competitive Age, the Integrated Review of Security, Defence, Development and Foreign Policy." The objective of the review was to describe "the government's vision for the UK's role in the world over the next decade and the action we will take to 2025."

The starting point for the Integrated Review's analysis was to ask why it was necessary in the first place. It also makes sense to look at the role of the Defence Review in the development of British defence strategy and defence procurement over the years. Suffice to say, previous experience of Defence Reviews by the British military and the supporting defence industry has not been a positive experience. To understand the current state of the military and the less than positive consequences of past reviews requires a brief discussion of these documents.

The road to the latest Integrated Review begins with British politics and the question of Britain's place in Europe. Two years after joining the European Economic Community (EEC) on 1 January 1973, a national referendum on continued membership in 1975 returned a figure of 67.23% supporting continued EEC membership. At that time, opposition to the EEC was to be found mainly on the left of the Labour Party and the right of the Conservative Party; it was therefore not an issue at the top of the British political agenda.

Divorcing Britain from Europe

Europe would soon become a toxic issue in British politics though and would be the primary cause of Margaret Thatcher's downfall as prime minister in November 1990. Almost a quarter of a century later, in an effort to defuse the still thorny European question, prime minister at the time, David Cameron, in fulfilling a manifesto pledge, made a commitment prior to the May 2015 general election to hold a referendum on continued EU member-

Photo: Royal Navy

The carrier HMS QUEEN ELIZABETH and elements of the Carrier Strike Group (CSG) at sea off Scotland. The CSG is visible proof that Britain wishes to remain a player on the global stage.

ship. At the same time, his government renegotiated many aspects of the British relationship with the EU to develop the basis for a more tolerable relationship between London and Brussels. Cameron won the election with a small majority, and the road to the EU Referendum vote on 23 June 2016 began. Believing that some form of assistance from Brussels and European leaders would allow him to present British voters with a positive picture of the EU and Britain's place within the bloc, Cameron failed to receive the help he expected. Perhaps both the EU and the pro-EU camp in the UK had misread the British electorate, making the result of the referendum even more shocking. The EU issue would then cause the demise of another Conservative prime minister as Cameron resigned just one day later.

Brexit has since dominated British politics to the exclusion of virtually everything else. Theresa May followed as prime minister, and was in office until July 2019, when she too became another Conservative leader toppled by the issue of Europe and UK's place within the EU.

The end of Theresa May's tenure as prime minister triggered a leadership election within the Conservative Party bringing Boris Johnson to power on 24 July 2019, though with no clear majority. Johnson soon realised, which many others did not, that the government and the Conservative Party had to deliver Brexit or it was game over for them in government. Eventually, in the face of a hostile parliament and elite opinion, the government called an election for 12 December. Johnson had read the mood of the country correctly, winning 43.6% of the popular vote, the largest percentage achieved since 1979 and a majority of 80 seats in Parliament. Consequently, Brexit finally became a reality.

Post-Brexit Britain was now in a totally different situation. Historically, the UK had never been a continental power, but as the EU was moving towards 'ever closer union' it felt it too was being drawn in that direction. Now Britain was forced to chart a new course and that course had to be beyond Europe. The UK's new global focus would impose new circumstances and challenges on the country in terms of its economy and security considerations, which made the generation of an Integrated Review a logical course of action to take.

The Curse of the Defence Review

In February 2020, the House of Commons library produced an extremely timely briefing paper entitled "A Brief Guide to Previous British Defence Reviews." According to the paper, "A defence review enables a government to present a forward-looking assessment of Britain's strategic interests and requisite military requirements. It examines the defence and security landscape, identifies current and emerging threats and then decides how best to organise and equip the Armed Forces."

The definition of a defence review would be classified as a "strategy-led review" as noted in the paper, but there is another type of defence review, and this is the "Treasury-led review." Put simply, this type of review is driven by the need to save money or to direct government spending elsewhere from defence for political reasons. It should be noted that in the British experience one can also have a "strategy-led review" and do things for all of the right reasons and then end up failing due to the fact that the available funding was insufficient to support the strategic vision outlined.

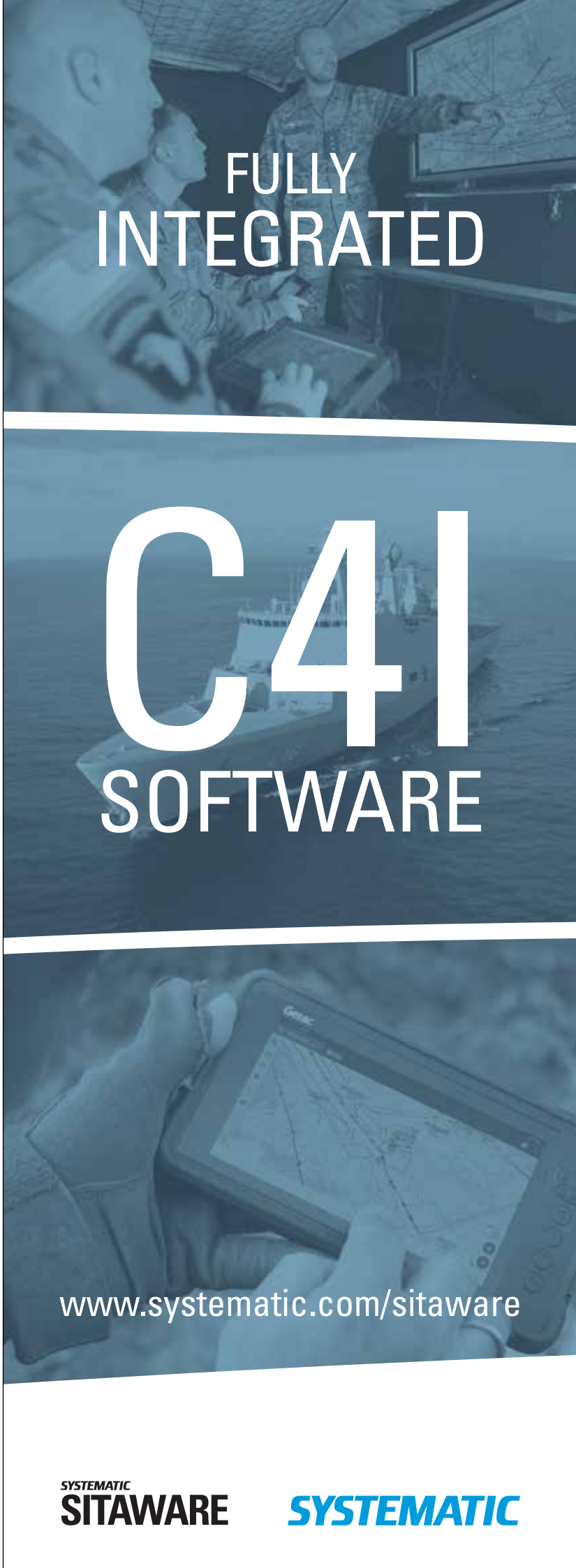

Photo: Crown Copyright

The F-35B Joint Strike Fighter (JSF) is the heart of the HMS QUEEN ELIZABETH air group. Prior to the release of the Integrated Review and the Defence Command Paper there had been speculation that the British might cap their JSF fleet at the 48 aircraft they are contractually committed to; the government has been at pains to deny this rumour.

Over the years, it has proven extremely difficult for Britain to define a logical long-term defence strategy and then provide sustained funding to support that strategy. One could argue that the reasons for that can be found in the period immediately after WW II, when Britain might have emerged victorious from an existential struggle, but the country was essentially bankrupt. Despite this, Britain had global security commitments. The end of the Empire and the resultant conflicts that were spawned only complicated the security picture, added to which were the opening moves of the Cold War. In an ideal world, the British government of the day wanted to rebuild the country, establish a national social welfare system and reduce the size of the military and its supporting defence industry.

From the outset, Britain had more defence commitments than it could afford. British forces were deployed in continental Europe, in Africa, in Asia and the Middle East. Beyond that, Britain was embarking on developing its own nuclear deterrent. All of this cost huge sums of money, money Britain simply did not have. Matters took a turn for the worse with the outbreak of the Korean War forcing Britain to initiate a rearmament programme and defence spending rose to nearly 10% of its GDP.

Despite these economic pressures, there were still those within the British government and upper echelons of the state that still regarded Britain as a great power, albeit in reduced circumstances, but still great, and with strategic autonomy. This was proven false as the Anglo-French operation in Suez in 1956 collapsed in the face of US opposition. This and the unsustainable burden of defence expenditure led to the 1957 Defence Review conducted by Defence Minister Duncan Sandys. This review famously contained the extraordinary assertion that 'the age of the manned aircraft was over,' which led to the cancellation of a host of aircraft programmes severely damaging the British aerospace industry. Cuts were made to the military and conscription was ended. Nevertheless, Britain still found itself with a global defence presence, though much more thinly spread.

The next round of review efforts came in the 1960s under successive Labour governments, They contended that the British military was "seriously overstretched and in some respects dangerously under-equipped" and they also stated that "there has been no real attempt to match political commitments to military resources, still less to relate the resources made available for defence to the economic circumstances of the nation." These comments were absolutely correct, but the real reasoning behind the series of reviews was to reduce defence spending. These reviews (known as the 'Healey Reviews' after Defence Secretary Denis Healey) between 1965-1968 led to the decision to withdraw from commitments "East of Suez" and to draw down other troop commitments. In addition, a whole string of major programmes were cancelled. It should also be noted though that the 1960s was the era of fielding a nuclear deterrent with four SSBNs equipped with the UGM-27 POLARIS missile system, an incredibly expensive programme.

Photo: Crown Copyright

An RAF EUROFIGHTER TYPHOON FGR4 over the Falkland Islands, the RAF will retire 24 early model Tranche 1 TYPHOON aircraft by 2025. However, the Future Combat Air System programme, with the TEMPEST aircraft as its primary component, continues to receive significant development funding.

In the 1970s, the Conservative government of 1970-1974 did little to change the decisions taken in the 1960s, but when a Labour government returned in 1974, they embarked on another round of cost reductions. Four primary defence roles were identified; these were British forces in Germany, the Atlantic ASW mission, home defence of the UK and the nuclear deterrent. Out-of-area capabilities and commitments would bear the brunt of these defence cuts.

The nuclear deterrent programme remained immune from cuts and the need to upgrade the performance of POLARIS saw the CHEVALINE programme undertaken to provide a counter to increasing Soviet ABM capabilities, another expensive effort, but worse was to come. There had to be a POLARIS replacement programme and the UK negotiated the acquisition of the TRIDENT missile system from the US, but the cost of this was far more than had been expected, not to mention the cost of four new VANGUARD class SSBNs and support facilities. This led the incoming Conservative government to embark on a defence review to cut costs in order to be able to afford TRIDENT.

The cuts outlined in the 1981 Defence Review had not taken effect when in April 1982, Argentina invaded the Falkland Islands (Las Malvinas) and Britain just about had the capability remaining to assemble a Task Force to retake the Falklands. In the post-Falklands period, a number of cuts were halted or reduced, and although an out-of-area capability had been resurrected, the primary focus remained dealing with the Soviet threat. The collapse of the Soviet Union and Warsaw Pact, brought about another review, this time entitled "Options for Change" in 1990. The end of the Soviet threat offered the opportunity to rethink British strategy, but it also offered the golden opportunity to reap a 'peace dividend' and redirect money cut from defence to more politically productive areas. This was followed by the 1994 "Front Line First" review, allegedly an effort to cut unproductive and unnecessary support functions from the military and the MoD. As before, this was a money saving measure.

Photo: Crown Copyright

The WARRIOR Capability Sustainment Programme (CSP) has been cancelled, some 767 WARRIOR are in inventory and nearly 600 were to be upgraded with an ISD of 2024, some seven years later than planned. The programme was £227M over budget and no deliverable capability was in sight, hence cancellation.

A new Labour administration elected in 1997 began with a foreign policy and defence review in the shape of the Strategic Defence Review (SDR) in 1998 and the SDR New Chapter of 2002. The SDR looked at maintaining ground forces that were more flexible and rapidly deployable compared to the traditional heavy mechanised units that the Army had focused on for years. The 2002 document reflected the changing security situation post-9/11. The future was to be one of small and asymmetric wars. At the same time, military technology was evolving

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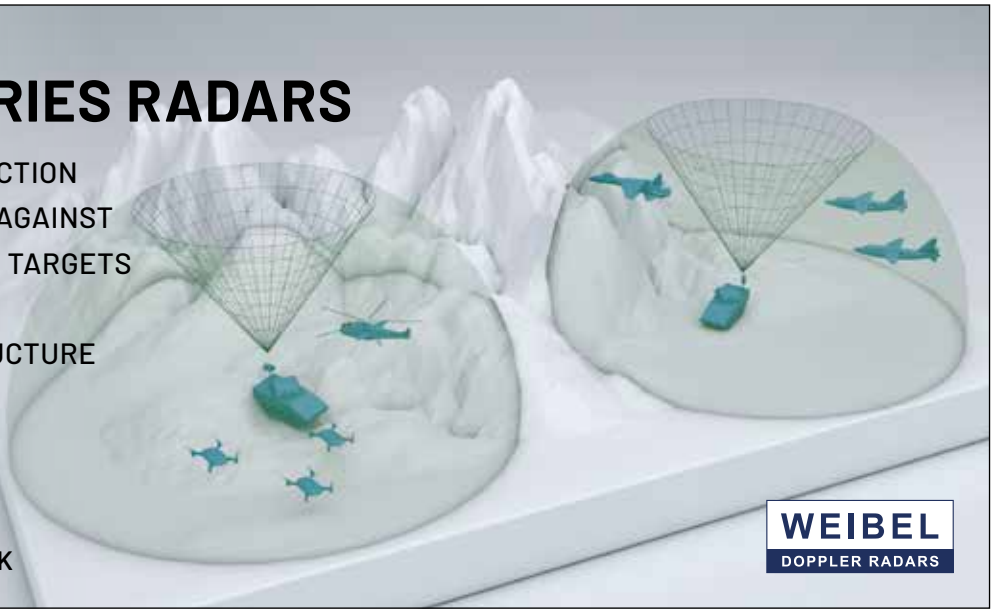

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The Royal Navy SSBN HMS VANGUARD departs Faslane, Scotland, on a deterrent patrol. The British nuclear deterrent is invested in four VANGUARD class submarines. The successor will be the DREADNOUGHT class and the first two units are already in build. The Integrated Review calls for the number of British nuclear warheads to be increased.

and the future was to be based on digitisation and Network Enabled Capability (NEC) and these technologies would apparently be transformative and change everything.

But Britain later became embroiled in Iraq and Afghanistan, with budgetary control and programme management becoming even weaker than previously with spend exceeding budgetary limits.

The coalition government which came to power in 2010 commissioned a Strategic Defence and Security Review (SDSR) which was delivered, along with a new National Security Strategy (NSS) document in October that same year. There were some positive elements in the SDSR, though at the same time, significant cuts in equipment and personnel were identified.

In November 2015, a new SDSR was released which recognised that Britain faced threats from terrorism, instability and extremism, as well as more conventional threats from state-level actors and increased competition between states. Trans-national issues such as cyber threats, plus the decline of a rules-based international order added to the overall threat matrix. The SDSR wanted Britain to have the ability to project power globally and allocated increased funding to the equipment plan. However, personnel numbers were reduced and it became apparent that the increased funding promised was an illusion.

Delusions of Grandeur?

Five years and five months after the release of the 2015 SDSR came the new Integrated Review, and for Britain the world is now a very different place than in 2015. Britain inevitably has to look globally in the post-Brexit era, and has made significant progress in signing trade deals around the world, reflecting its return towards a vision of a global trading nation. Yet it is doing so at a time when its own economy and the global economy are under extreme pressure from the consequences of the COVID pandemic. Economic recovery will come, but the consequences of the vast increases in public expenditure during COVID have yet to be truly felt and measures to pay off public debt will have to be carefully calibrated to avoid damaging the national economy. The question of money is critical to the Integrated Review. The government notes that it has "made the biggest investment in defence spending since the end of the Cold War, exceeding NATO's 2% spending guideline." This sounds impressive, but it begs the question whether it can be sustained with public finances under so much pressure? If that were not enough, Britain is also engaged in modernising its nuclear deterrent, with the first two of four DREADNOUGHT class submarines already in build, and as previous defence reviews have highlighted, modernising the nuclear deterrent places immense pressure on the defence budget, leading to the cancellation of conventional defence programmes.

What is also clear from this analysis of previous defence reviews is the immense difficulties the government and the MoD seem to have in managing cost and delivering capability at the desired point and the desired price. You can celebrate increasing the defence budget, but that is pointless if it cannot manage programmes properly.

The recently cancelled WARRIOR Capability Sustainment Programme (WCSP) reflects these trends. A recent report by the House of Commons Defence Committee noted that, "Despite having spent around 50% of the allocated budget (£800M), the programme has yet to place a manufacturing contract. The programme has a current in-service date of 2024 (originally planned for 2017) and is some £227M over budget." The Committee described this as "symptomatic of the extremely weak management of Army equipment programmes." It is not just Army programmes though, as it is happening across all major defence procurements. If it wants to pursue its global ambitions, Britain must prioritise resolving the financial problems related to defence and defence procurement.

Finally, Britain has to be realistic in its future strategic choices. It must be remembered that Britain is by inclination and reality a global trading nation. It is also the fifth largest economy in the world. However, in a military context, while Britain can project power, it remains limited in this regard, so it must therefore operate with allies, whether that be the US, European nations or regional states around the world. At the same time, the UK must remember to keep its own strategic and economic interests paramount rather than blindly following larger allies. Britain possesses credible military capabilities. Unfortunately, these capabilities are limited and Britain cannot afford to over-commit as it has done all so often in the past. To conclude, at this point in time, the Integrated Review remains balanced between a credible strategic solution and yet another missed opportunity. Only time will tell what the outcome will be. ■

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The Afghanistan Dilemma: to Withdraw or not to Withdraw?

Dr. Andreea Stoian Karadeli

With a deepening security vacuum on the ground and the insurgent threat winning more and more terrain day by day, many are wondering whether the decision to withdraw comes at the right moment. Almost twenty years have passed, and Afghanistan reflects the same dilemma for Western forces: what should be the next step?

US President Joe Biden announced the withdrawal of all US troops from Afghanistan this year by 11 September, thereby giving symbolic closure to the cycle of violence started by the fatidic 9/11 attack.

The first US troops deployed to Afghanistan on 26 September 2001. Back then, the mission was expected to last no longer than the coming spring. Strategically planned for just a few months, the war on terror fought on Afghan land has claimed the lives of over 100,000 civilians and 60,000 security forces.

In 2001, the US Army entered Afghanistan in search of what had become the US's main enemy overnight – al-Qaeda. The terrorist organisation responsible for the 9/11 attacks was hiding in the Taliban's safe haven making it crucial for the US to get boots on the ground. The Bush administration assured the public that a "war on terror" represented the only way to destroy al-Qaeda and prevent the terrorist group from using Afghanistan as a base to launch another terrorist attack on the West.

In less than six months, most of al-Qaeda's leadership structure was either captured, killed or had fled Afghanistan. It took ten years to finally find and kill Osama bin Laden, in Pakistan. Meanwhile the jihadi phenomenon went beyond the al-Qaeda framework and morphed into a complex global insurgency, with intertwined military and political agendas. Twenty years of a vicious terror and counter-terror cycle fuelled with violence, and constantly reproduced under different operational names. Whether or not the US is ready to close this circle and turn the page remains to be seen. What is certain is that regardless of the final decision, there will be consequences at both regional and international levels. Faced with criticism by many politicians and scholars, the withdrawal is actually the true reflection of an Afghanistan dilemma that has weakened all of the West's political and military agendas. Once opened, the Pandora's box becomes impossible to close and we have already witnessed its chaos in Iraq. Afghanistan has the potential to be an even more dangerous version of the mythical box Nevertheless, hope – the last thing left in the box - remains a deceptive expectation for peace and stability on the ground.

Photo: US Army

US Army Rangers 'INFIL' (infiltration) by CH-47 CHINOOK helicopter is the most common means of getting to remote elevations where armoured vehicles cannot be used.

Author

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From a Few Months to Twenty Years

After deploying to Afghanistan just a few weeks after the 9/11 attacks, the US military began a bombing campaign against Taliban forces, officially launching 'Operation Enduring Freedom'. They received the support of Canada, the UK, Australia, Germany, and France. In the early phase of the war, US air strikes on al-Qaeda and Taliban forces were assisted by about 1,000 US Special Forces,

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Photo: US Army

The first American forces entered Afghanistan just a few weeks after the 9/11 attacks.

the Northern Alliance, and ethnic Pashtun anti-Taliban forces. At the peak of the war a decade later, the US had more than 100,000 troops battling the Taliban.
Since the first strike, both the US strategy and objectives in Afghanistan have become ever more blurred, leaving room for confusion, misunderstanding and never-answered questions: Who is the enemy in Afghanistan - al Qaeda, the Taliban or both? What is the final accomplishment expected from the troops on the ground? What is the actual threat map of the armed fractions in Afghanistan?
For almost two decades, the US has legitimised its military operations as 'Operation Enduring Freedom' (2001-14) and 'Operation Freedom's Sentinel' (from 2015 to the present), without a well-structured, context-oriented or at least, feasible strategy. From the start, the Bush administration failed to offer any details about its plan in Afghanistan, nor did he make any indication about how long US troops would have to remain. The next two American presidents, Barack Obama and Donald Trump, were guided by the very same phantasma of victory over an unclear enemy on a foreign and distant land. Just like President Bush, his successors vowed to win in Afghanistan, without having a clear perspective on what that victory was supposed to represent.
In the same way, since 9/11, the jihadi threat has been changing and adapting to the global opportunities of the digital age. Although defeated at first, the Taliban have risen from their own ashes and are now stronger than ever, controlling numerous territories and making obscure partnerships based on their interests and local contexts. Based on several official reports, the Taliban are in a stronger military position now than at any point since 2001, although it must be underlined that a lot of once-public data related to the conduct of the war have been classified or are no longer produced. The main enemy responsible for the US military presence, al Qaeda, is still assessed to be active underground in Afghanistan and its decades-long ties with the Taliban remain strong as reported by the UN missions on the ground. On the other hand, the Afghan state, backed by America and its NATO allies, is still too weak to govern on its own.
Twenty years of perpetual violence has created a security and stability vacuum – the perfect ground for terrorist groups to thrive. The escalation of violence has been the main argument for the military intervention, but, in fact, those two elements are in a symbiotic toxic relationship that have undermined Afghanistan's capacity as a state to develop its own self-healing mechanisms. Although US troops have been struggling to provide assistance to the Afghan security forces in order to be able to fill the security vacuum, there is still much to be done, but clearly in a manner other than a never-ending foreign military presence.
The number of troops in Afghanistan reached a peak of 100,000 at the time when Osama bin Laden was found and killed in Pakistan. Late on, the Obama administration declared that the main goal of the military presence had been achieved and promised a gradual withdrawal of troops. By the end of his term, the number of deployed troops had been reduced to below 10,000.
After a period of uncertainty and violent clashes, the Trump administration brokered a deal with the Taliban at the beginning of 2020 that would ensure a permanent ceasefire and reduce the US military presence from approximately 13,000 troops to 8,600 by mid-July 2020. Based on the agreement, all foreign forces were expected to leave Afghan lands by May 2021. In return, the Taliban promised it would stop terrorist groups from using Afghanistan as a base to launch attacks against the US or its allies and agreed to conduct peace talks with the central government in Kabul.

Biden's Withdrawal Commitment

With the peace deal inherited from his predecessor, many have wondered what President Biden's decision will be regarding the Afghanistan war. In fact, the current president is no stranger to this issue. During his term as vice-president in the Obama administration, Joe Biden supported a withdrawal that would have left only a small counter-terrorist force on the ground. Although back then, his proposal was not accepted, on 14 April 2021, President Biden announced that every American soldier would leave Afghanistan by 11 September - the 20th anniversary of 9/11. Although criticised from many sides, President Biden is the first US president to clearly state that the US's reasons for remaining in Afghanistan have become unclear after the killing of Osama bin Laden, as the terrorist threat has since dispersed across the globe. He is also the first president in 40 years to have a child serve in the US military and serve in a war zone, making him more personally attached to the issue.
Still, there remain a number of unknown variables regarding the withdrawal vs. peace deal made with the Afghan sides party to the conflict. On the one hand, the Taliban have already failed to fulfil the promises made to the previous administration, as part of the deal. In January 2021, America's Treasury Department noted that al-Qaeda members remained "embedded with the Taliban". Reports regarding the close ties between the two groups have come from various agencies, and especially from the UN. Many of the current administration's military advisers have argued against a withdrawal, warning that the Taliban would seize the country and set back women's rights by decades. Moreover, the Taliban rejected the invitation to attend a forthcoming meeting in Turkey that would have discussed, among other things, the formation of an interim government and the future of Afghanistan after foreign military forces withdraw.

The situation on the ground is also worsening, proving the inability of the Taliban to respect their commitments with regard to the peace deal. Based on several UN reports, civilian casualties have been on the rise in the first months of 2021, registering 29% more deaths than in the first quarter of 2020. Although the Afghan Government is officially in control of most of the territory, several cities, including Kabul, witness repeated suicide bombings and increasing violence. In contrast to President Biden's declarations, the reality on the ground contradicts the plans for a complete withdrawal and proves that the US administration may be unable to ensure that the Taliban live up to their commitments.

The current situation and the military withdrawal plans set the stage for many analysts to draw a parallel to Afghanistan in the 1990s, when the Taliban ousted the rulers after the Soviet Union withdrew and stopped the funding. In this case, a Taliban victory could mean the re-imposition of a pious, pre-modern tyranny. Therefore, based on the lessons learned from the Soviet withdrawal from Afghanistan, American officials say they will continue to financially support the government in Kabul, hoping that this may help maintain at least some level of stability in the country. However, the departure of the US and its allies will create a power vacuum that Pakistan, a long-time supporter of the Taliban, and India, a fervent opponent, will seek to fill, along with China, Iran and Russia. A war that began with the Soviet invasion in 1979 will be given a new blank page to fill.

NATO's Position

The NATO mission in Afghanistan was launched after the Alliance activated its mutual defence clause — known as Article 5 — for the first time in the wake of the 9/11 attacks. As a result, the North Atlantic Alliance joined the international security effort in Afghanistan in 2003 and, according to the data released in March 2021, the current NATO-led mission in Afghanistan, known as 'Resolute Support Mission', has around 10,000 troops, of which 2,500-3,500 are US forces. Since early 2015, the mission has trained, advised, and assisted the Afghan National Defence and Security Forces, when they assumed responsibility for security nationwide.

In support of President Biden's position, "in together and out together", NATO Secretary General Jens Stoltenberg declared from the Alliance's headquarters in Brussels that the "drawdown will be orderly, coordinated and deliberate." In a broader context, taking into consideration the situation on the eastern flank and Russia's threatening steps towards Ukraine, the Afghan withdrawal may also be to the benefit of the Alliance, already facing challenging times.

Photo: DoD

In 2012, former Taliban fighters line up to handover their rifles to Afghan authorities during a reintegration ceremony at the provincial governor's compound. The re-integrees formally announced their agreement to join the Afghanistan Peace and Reintegration Programme during the ceremony.

A Portrait of an Unknown Afghanistan

The US is not the first foreign power to have entered Afghanistan only to be tricked by the mirage of a close military victory. Historically represented as the "Graveyard of Empires", Afghanistan is not an easy country to rule or control. Over time, many empires and nations have tried and repeatedly failed to pacify what is today the modern territory of Afghanistan. And each of those trials left deep scars that have made it even more complex and harder to understand. This is, in fact, the main issue when it comes to Afghanistan and, in general, with regard to the never-ending war on terror. While going after their national interests, the Western actors which became involved in Afghanistan never really understood the local and regional context – also translated as the reality on the ground. They

Photo: Captain Joseph Hardigree, United States Army

Afghan National Police detaining suspected Taliban in Shergah and Zaylabach villages, Khakriz, Afghanistan

Photo: CC / Al Jazeera English

The bomb disposal team of the Afghan Army 215 Corps neutralises an IED in Sangin, Helmand. With roadside bombs the largest threat in Afghanistan, the few teams that have been trained are heavily relied upon to keep the roads safe for troops and civilians.

have not even tried, making the concept of cultural understanding a very broad and theoretical term among the military. When the first US troops entered Afghanistan, they were unfamiliar with the cultural and regional dynamics. They were not aware of the crucial importance of tribal linkages within the texture of Afghan society. It was only when the conflict and the violence worsened, and the military strategies did not fit the reality on the ground that the troops and their leaders began to realise that they needed to understand both their partners – the Afghan actors to whom they provided support – and their enemies.

In a nutshell, the complexity of Afghanistan is also the result of three interrelated factors: geostrategic location; history of invasion; and the challenging physical environment. To begin with, Afghanistan is located on the main land route between Iran, Central Asia and Pakistan, making it the epicentre of hostilities, contrasting interests and regional power struggles. Secondly, the repeated history of invasions witnessed by the communities found on this land have resulted in the prevalence of tribalism in the area. Any reader familiar with the Afghan culture will immediately understand this through the image of villages and houses built as fortresses. Thirdly, the physical terrain of Afghanistan, dominated by some of the highest and most rugged mountains in the world, is a perfect match for the tribal structure of its society. Moreover, the geographical factor makes it harder for foreigners to adapt, while it provides a strategic advantage to the local groups. After 20 years on the ground, we are still far from having a clear understanding of the complex dynamics that define Afghan culture and society. This should be the first objective in case we are interested in remaining in Afghanistan in a non-military form, such as humanitarian assistance.

Afghanistan after September 2021

In 2010-2011, I was living in Syria and witnessed, together with the locals, the US troops leaving behind a weak, unstable and deeply hurt Iraq. It did not take long for the Salafi-jihadi ashes to gather and create an even bigger fire that, eventually, swallowed neighbouring Syria. Both Iraq and Afghanistan are examples of large-scale warfare in the wake of 9/11. Although difficult to draw parallels, it is hard not to wonder if the future of Afghanistan after the withdrawal of foreign troops will resemble thatof Iraq.

America's longest war in history might end this year, leaving behind a weak Afghanistan, trying to balance on a knife-edge. The current government has failed to win the trust of its population, and is accused of complacency and corruption. The Afghan security forces, trained since 2015 by foreign troops, have limited capabilities and resources, and remain too weak to defend the citizens. The Taliban is becoming more powerful by the day, increasing their attacks and refusing to fulfil commitments to the peace plan. Personally, I would argue that Afghanistan's current context, hindered by ongoing violence and terror, might force the troops to return.

Terrorism and Counterterrorism

As acknowledged by CIA Director William Burns, the US withdrawal will weaken the ability to act on threats emanating from Afghanistan. That is a direct consequence of the withdrawal over the counterterrorism struggle in the region. Still, the Biden administration declared that the US government will retain a suite of capabilities that can help to anticipate and fight against any extremist threat. This might be translated though as counterterrorism via long-distance methods, such as drones and Special Forces. Still, the bases for these capabilities need to be located in close proximity: Central Asia or Pakistan. Although feasible, such an arrangement takes time and international effort. Meanwhile, the extremist groups that are already active on the ground have all the interest to seize the opportunity and act on the spot.

Conclusion

The US military withdrawal is a double-edged weapon: while it marks the closure of a vicious cycle that has resulted in more losses than gains, it also turns a blank page to be filled by uncertainty. Twenty years serve as proof that continued military operations, including drone strikes and targeted killings generate and fuel further conflict in the long term. At the same time, ending the foreign military presence creates a potential power vacuum that may allow the Taliban to regain control. Whatever option is chosen, there will be consequences and both regional and international actors need to be ready to face what comes next. They need to be ready to listen, understand, discuss, cooperate and negotiate for peace and stability. Clearly defining the end-goals would be necessary for the future of Afghanistan. Although preventing terrorism may be a worthwhile target, a continuation of a violent strategy is not a viable long-term solution. Unless the strategy from now on is developed around the security of the Afghan people and stability in the region, there will be more bloodshed, strengthening the argument for the return of foreign troops and for the vicious cycle to start spinning once again. ■

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What is Spain's Current Role in the International Security Environment?

Esteban Villarejo

The Spanish Armed Forces participate in 17 missions abroad. It is foreseen that by 2021, the highest number of troops simultaneously deployed will not exceed 2,900. This excludes occasional adjustments in some of the missions depending on requirements, such as those derived from the temporary exercise of command over international forces, or due to the health and security situation.

Currently, the largest Spanish contingents are deployed in Lebanon, with over 600 blue helmets, and in Mali, where almost 400 troops are serving. Within NATO's area of operations, Spanish military personnel are monitoring the waters of the Mediterranean and are taking part in the defence of the Baltic states and Turkey. Spain is also present in all European Union military missions on the African continent, with deployments in Mali, Central African Republic, Somalia, and Senegal, as well as in EU NAVFOR (Operation Atalanta), whose mission is to counter acts of piracy in the Indian Ocean.

The map below highlights the participation of Spanish military units and observers in operations abroad:

Photo: EUTM

Spanish soldiers held a Tactical First Aid and Medical Evacuation Exercise at Koulikoro Training Centre in Mali in March 2021. Trainees practiced treating casualties in combat and conducting medical evacuation by different land and air means.

NATO

Latvia, Enhanced Forward Presence

The Spanish contribution to NATO's Battle Group in Latvia is visible in the troops that make up a Mechanised Tactical Subgroup, an Engineer Unit, different posts within the Battle Group's Headquarter Command and in the multinational Latvian Brigade, as well as a national support element, which includes the Logistics Unit. Spain has roughly 350 troops deployed in Latvia.

The main resources provided by Spain are the LEOPARDO 2E main battle tanks and the PIZZARO infantry fighting vehicles (IFV). This is the first time that Spain has deployed these types of resources on a foreign mission.

Moreover, other mechanised resources are also deployed, such as the M-113 armoured personnel carrier, heavy mortars, engineering vehicle (VCZ) and the anti-tank guided missile SPIKE. The contribution of units that substantially improve the fighting capability of the Tactical Subgroup should also be mentioned, such as the Joint Terminal Attack Controller (JTCA) and an unmanned aerial vehicle (UAV), named "Raven".

Lithuania, Baltic Air Policing (BAP)

This year from May until August, Spain is contributing six EUROFIGHTERs to NATO's Baltic Air Policing Mission in Lithuania. The contingent is known as the "Vilkas Detachment". In addition to its air assets, the Spanish Air Force has deployed around 150 personnel within the contingent who are responsible for all maintenance, logistics, surveillance and control tasks of the detachment.

This will be the seventh consecutive year in which Spanish fighter jets deploy to the Baltic with NATO: Estonia (2015, 2017) and Lithuania (2016, 2018, 2019 and 2020).

Iraq, Operational Support

Roughly 200 Spanish troops contribute to the Combined Joint Task Force with the aim of instructing and training Iraqi security forces in the fight against DAESH. These activities are now carried out by instructors at the Baghdad Diplomatic Support Centre, where troops belonging to the Iraqi Counter-Terrorism Service (CTS) are being trained by the Coalition's Special Operations Task Group (SOTG).

"Task Force Toro" (Helicopter Unit) also makes up part of the Spanish contingent operating from the Al Asad Air Base. Its main mission is to provide air transport to Coalition troops. Spain has deployed COUGAR helicopters for this task.

The Spanish Armed Forces continue to provide security as part of the overall fight against terrorism in Iraq together with its allies within the NATO Mission – Iraq (NMI).

Photo: Ministerio de Defensa

Spanish soldiers and members of the Lebanese Armed Forces patrolling a border fence near Beirut, Lebanon

For this specific mission, Spain is contributing seven service personnel. In addition to this contribution to NMI, Spain has assigned five service personnel to the US Central Command HQ (US CENTCOM) located in Tampa, Florida, USA.

Afghanistan, Resolute Support

At present, the Spanish contribution to the NATO Resolute Support (RS) Mission in Afghanistan (24 military personnel and two national interpreters) is as follows: two servicemen in the RS HQ.; eight service personnel in the Spanish National Support Element (NSE); and 14 military staff members of the Special Operations Force (SOF).

Turkey, Operational Support

This unit deployment was authorised by an agreement of the Council of Ministers on 26 December 2014, which extended the participation of units and military observers to operations outside Spain's national borders. As a result of this decision, Spain demonstrated its support and involvement to Turkey's security.

The mission is purely defensive in nature and, according to NATO, it demonstrates the existing solidarity between NATO Allies and serves as an example that collective defence remains the "cornerstone" of the Organization. On 11 December 2015, the Council of Ministers authorised an extension up to 31 December 2016, with a ceiling of 150 troops. The first contingent deployed to Turkey on 29 December 2014, taking over from the Dutch unit at Adana airport one month later. In January 2016, the Spanish Patriot Unit was transferred from Adana airport to Incirlik Air Base.

At present, the Patriot Unit is made up of 149 military personnel, based on the Anti-Aircraft Artillery Command Units, as well as personnel from the Canary Islands Command.

Photo: Ministerio de Defensa

Spanish soldiers and soldiers from Mali conducting a joint patrol under the European Union Training Mission (EUTM Mali)

NATO Standing Naval Forces (SNF)
The 2017 Military Planning Directive references the operational situations in which the Joint Force (JF) can participate, in addition to Spain's contribution to deterrence, which involves "actions of advanced presence and contribution to the Response Forces in the field of NATO and EU". The overall mission assigned to NATO by Spain is for its assets to conduct the deployment, withdrawal and coordination in support of the naval forces in the NATO groups (SNF) and to monitor the activities and operations carried out by the deployed units. The planned Spanish contribution is as follows:

- SNMG-2: Frigate for a period of six months as a command ship (frigate MENDEZ NUNEZ currently); for a period of two months.
- SNMCMG-2: Minesweeper for two six-week periods.

Operation SEA GUARDIAN in the Mediterranean
With the approval of the Council of Ministers, Spain is contributing the following units to NATO's Operation Sea Guardian:

- An average of four flights per month by a Maritime Patrol Aircraft (MPA);
- One submarine for two periods of 45 days, one per semester;
- An offshore patrol boat ready to deploy within 48 hours on request;
- A leading command ship with an onboard staff available on request;
- Permanent diplomatic authorisation for Cartagena and Rota naval bases.

Spain also offers support, upon request, to those naval units in transit within Operation Sea Guardian's area of operations.

Photo: EUNAVFOR

The amphibious assault vessel CASTILLA on patrol during Operation ATALANTA

Romania, Enhanced Air Policing
This year, for the first time, the Spanish Air Force deployed six EUROFIGHTER jets to Romania for a two-month period (February-March). Besides these air assets, the Spanish Air Force deployed roughly 130 air personnel responsible for the maintenance, logistics, surveillance and control tasks of the detachment. The deployment is expected to be repeated next year.

European Union

Mali, European Union Training Mission (EUTM Mali)
Spanish participation, with a maximum of 50 armed forces personnel, was authorised by Congress on 30 January 2013. On 1 April 2013, the first Spanish troops were deployed to EUTM Mali. The size of the contingent was increased in 2018 and Spain is now the largest contributor of forces (24%). Currently, Spain's contribution to this mission is around 400 service personnel.
Spanish troops are mostly deployed in the town of Koulikoro, northeast of the capital, Bamako where they carry out the training of the Malian military. Once their first period of training and instruction is completed, Malian troops are sent to the north of the country to face the Jihadist groups that still operate relatively freely in that area.
Spain is now leading the EU mission with a General, Fernando Gracia. Spain expects to deploy a transport helicopter detachment in the coming months.

Indian Ocean, EU Operation ATALANTA
As part of its commitment undertaken under the EU flag Spain contributes to the overall security in the Gulf of Aden and Somali waters, by protecting the Somalia-bound vessels and shipments belonging to the UN's World Food Programme and the African Union Mission to Somalia (AMISOM).
Since its beginning in 2008, Operation Atalanta has contributed to increased security in the Indian Ocean. The Spanish Navy's amphibious assault vessel (BAA) CASTILLA was deployed for a four-month period in February this year, but due to mechanical issues, it has since been replaced by the frigate NAVARRA in the EU Naval Force's theatre of operations.
Spain also contributes to Operation Atalanta with its Orion Detachment in Djibouti: this includes a P-3 ORION aircraft

Photo: Ejercito Aire

Spanish Air Force maintenance personnel on operations in Libreville in support of Operation BARKHANE

and 50 aircrew belonging to the Spanish Air Force, and the Operations HQ at Rota Naval Base in Spain.

Somalia, European Training Mission (EUTM)
Spanish participation in EUTM Somalia was agreed by the Council of Ministers on 23 April 2010, after Congress approved the Government's request. Spain was the first country to command this training mission when it was launched in Uganda in May 2010. The first Spaniards to arrive in the area were 18 instructors from the Army Training and Doctrine Command. They taught specialised training modules, including section command, urban warfare, communications, explosive ordnance protection and health care. Since January 2015, a "pool" of instructors has been available to teach all course content. Spain's contribution of service personnel includes two stationed in Brussels and 16 in Mogadishu, including the Chief of Staff and the Head of the Training Team, both of whom are Colonels in the Spanish Army.

Central Africa Republic, European Training Mission (EUTM-RCA)
EUTM-RCA is a non-executive defence mission with the aim of contributing to the EU's efforts in advising, teaching and training the Armed Forces of the Central African Republic. It aims to support the reform of the country's Armed Forces and strengthen their ability to contribute to the defence of their own territory and the protection of their own population.
Spain currently contributes eight service personnel to EUTM-RCA from the Spanish Army.
Linked to this mission was the Spanish Air Force's 'Mamba' detachment, which operated in Libreville (Gabon) since March 2014 to ensure logistics support for the Spanish troops deployed in the Central African Republic. The

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Mamba detachment ended its mission in March 2020.

Bosnia and Herzegovina, EU Force
Spanish Armed Forces personnel stationed in Sarajevo contribute to the development of the Bosnian-Herzegovinian Armed Forces by advising them in terms of doctrine, interoperability, standardisation and training. This will allow them to obtain the same capabilities and qualities as the rest of the NATO member countries.
Currently, Spain is contributing to Operation Althea with three service personnel, one of them in Mons (Belgium) and the other two in Sarajevo.

Cooperation with France

Senegal, Operational Support to Mali
France initiated Operation Serval in January 2013 to stop the advance of Jihadi groups towards the south of Mali, to prevent the fall of the capital (Bamako) and to liberate the main northern cities that had become a safe haven for terrorists. In the same month, Spain joined the mission with its decision to facilitate the overflights and temporary landing of aircraft from EU member states and with the deployment of the Marfil Detachment in Dakar (Senegal). Subsequently, Operation Serval was, along with other French operations in West Africa, absorbed into Operation Barkhane, to which the Spanish Armed Forces have continued to contribute. The mission is focused on the contribution of French intra-theatre transport through Operation Barkhane and the United Nations MINUSMA mission.
The Marfil Detachment supports the EUTM-Mali's Spanish contingent. Spain's contribution consists of two transport aircraft T21 (AIRBUS C-295) belonging to the Spanish Air Force and 65 Air Force personnel. The Marfil Detachment operates in 19 countries, covering an area of more than 5,200 square km.

United Nations

Lebanon, UNIFIL
The Spanish Armed Forces were deployed in Lebanon in September 2006. The entire contingent assigned to Operation 'Libre Hidalgo' is located at the Miguel de Cervantes Base, near the town of Marjayoun where the Spanish-led Eastern Sector Headquarters is located. There are also Spanish personnel at the UNIFIL Headquarters in Naquora.
Spanish troops carry out foot and vehicle patrols to monitor the line that separates Lebanon from Israel. They also establish observation posts and carry out other activities alongside the Lebanese Armed Forces (LAF), all of which are aimed at ensuring compliance with UN Security Council Resolution 1701 and preventing situations that could lead to an escalation in tension between the parties.
The Multinational Brigade East, led by Spain and commanded by a Spanish General, is composed of 3,500 troops of nine different nationalities. Spain's contribution to UNIFIL consists of roughly 600 troops. In addition, there are 14 positions assigned to Spanish personnel within UNIFIL's HQ (FHQ) in Naquora. Since the beginning of the mission, 15 Spanish service personnel have lost their lives in Lebanon.

Colombia, Verification Mission
Since 2016, Spain has deployed seven observers to Colombia in order to monitor and verify disarmament provisions, as well as participate in the tripartite mechanism which supervises the definitive bilateral ceasefire and cessation of hostilities following the signature of the Peace Agreement. Three Spanish Army Officers, one Naval Officer, one Legal Advisor, and two military policemen belonging to 'Guardia Civil' make up the Spanish contribution. The deployment of Spanish observers began in November 2016.

Diplomacy and Cooperative Security Activities

West Coast of Africa
In recent years, Spain has developed several cooperation activities on the African continent within the framework of its 'Defence Diplomacy' and as part of the contribution of the Armed Forces to the State's external action. These initiatives have been reflected in the deployments of naval units carrying out maritime security and cooperative security operations with various countries in West Africa.
The objective behind the deployment of a Spanish patrol boat is to develop the capabilities of African nations in the control of their own territorial waters through joint training exercises. This is why the vessel initially made stops in Mauritania, Gabon, Ghana, Senegal and Cape Verde, and which was later expanded to include other countries in the region. The patrol vessel FUROR is currently deployed in the area carrying out these duties. ■

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The Spanish Armed Forces in 2035

Looking Ahead: An Overview of the Country's New Military Strategy and New Capabilities Planning Cycle

Admiral General Teodoro Esteban López Calderón

Much has happened in the field of security and defence in the last few years. This is due largely to the global spread of a new era of great-power competition, hybrid threats, international terrorism and other forms of instability, all of which demand new types of responses and a strong commitment from the international community.

This strategic scenario has sparked a debate within the numerous international security and defence organisations and the different 'ad-hoc' coalitions that have emerged as a result of new political and military initiatives and projects. This includes the NATO Deterrence and Defence Concept, the EU Permanent Structured Cooperation (PESCO), and one of the most successful coalitions in recent history - Operation Inherent Resolve / Coalition against DAESH.

Introduction

In recent decades, the Spanish Ministry of Defence has chosen a multilateral approach for its political and military activity. We have demonstrated a huge commitment and contribution to international missions and operations with an average overseas deployment of 3,000 troops. Our participation in the hectic political and military discussions within the international community and our operational experience in the field, have provided us with useful guidelines to be taken into account as we adapt our military strategy.

In fact, a new Defence Planning Cycle was initiated in June 2020 through the enactment of a National Defence Directive (NDD), signed by the President of the Government, followed by a Defence Policy Directive (DPD) approved by the Minister of Defence. Both documents underline the importance of multilateralism in the current strategic context, and where NATO has returned to the collective defence approach, the European Union prefers a framework to promote peace and stability on our southern flank (Africa), with the United Nations remaining the key reference for international legitimacy.

Photo: Ministerio de Defensa

The NDD and the DPD also provide the Armed Forces with clear guidance on how to develop suitable strategies to face new threats and to improve military support to civil authorities. This has been proven to be a great success during the fight against the COVID-19 pandemic.

As the Spanish Chief of Defence Staff (CHOD), one of my main responsibilities is to determine and prioritise current and future military capabilities. The Spanish Armed Forces' capabilities must be completely intertwined with those of NATO and the EU, in order to achieve a fully integrated planning process.

Although some priorities may be different among our allies and partners, those processes are completely aligned because we share the same strategic objectives.

This alignment is further cemented using the common mechanisms agreed upon by the member states. In the following paragraphs, I will outline the Spanish planning process.

Taking different studies into consideration, and the political guidance regarding our planning process, we receive inputs from three different sources: national, NATO and the EU.

Besides addressing the issue of resources, the planning process needs to integrate many other aspects such as new concepts, digital transformation, emergent and disruptive technologies, industrial aspects and European and NATO cooperation initiatives. All these references are key to designing our future Armed Forces and to building the roadmap of our procurement process.

This integration of information is carried out during the two-year definition phase that ends once the "Long Term Force Objective" and the "Military Capabilities Objective" are approved by the Minister of Defence. The definition phase is followed by a six-year execution phase which includes an annual review.

But before diving into the details of our military strategy and our planning process, I will briefly describe the results of this 'Foresight Analysis'.

Foresight Analysis: Operating Environment 2035

Current trends identified globally show that we are moving towards a new era. The think tank of the Spanish Ministry of

Author

Teodoro Esteban López Calderón is a Spanish Navy Admiral General who has served as the 12th and current Chief of the Defence Staff of the Spanish Armed Forces since 27 January 2021. Previously, he served as Admiral Chief of Staff of the Navy from 2017 and 2021.

Defence, the "Instituto Español de Estudios Estratégicos", wrote a timely and interesting report entitled "Horizon 2040". This document is mainly focused on the identification of global geopolitical trends and their future possible impact on Spanish politics and society.

The publication of the "Operating Environment 2035" (OE 2035) represents a step forward. This paper not only highlights a security and defence perspective, but also informs about the military planning process as a consequence of the new planning cycle, which began in 2020 following the prime minister's guidelines. From the very beginning, this study clearly states that the new planning cycle must design innovative and transformative initiatives. Here, the challenge lies in how to prepare the "Joint Force" for new combat standards and different combat modalities in a multi-domain operating environment.

OE 2035 shows how the current trends interact with national interests and are able to create situations that will shape the future operating environment. In spite of all the difficulties involved in an unpredictable future, we can unequivocally state that the Armed Forces will continue to be one of the main instruments available to democratic states to influence in conflicts, guarantee collective and national defence, protect national interests, contribute to international stability and provide security and well-being.

However, the changes that lie ahead are of such magnitude that it is difficult to predict how we will operate in the future and what we will require to adapt to those changes. It also refers to our geographic position, located in a very complex area where security challenges are highly relevant. Nevertheless, Spain is the natural bridge between Africa and Europe that allows Spain, NATO and the EU to interact with our African partners.

Consequently, the main purpose of the OE 2035 is to describe the possible operational scenarios for the Armed Forces and the changes involved in successfully adapting to that uncertain, complex environment.

The first section analyses the challenges of the future operating environment, summarising them as the risks, vulnerabilities and threats that compromise national security; the main concerns are international armed conflicts, failed states, organised crime, terrorism, the proliferation of weapons of mass destruction, cyberattacks and disinformation campaigns.

The most decisive features that will characterise the OE 2035 include the upsurge of crises and conflicts with a diverse number of players who have the ability to exert influence both regionally, as well as internationally.

Photo: Ministerio de Defensa

Spanish Navy frigate CRISTOBAL COLON

Other key features of the OE 2035 are: the conventional and hybrid strategies merging into complex scenarios; changes in military organisations; technological developments in command and control systems; the predominant use of cyber and cognitive domains; densely populated urban areas as preferred sites for confrontation; varied access to anti-access and aerial denial (A2/AD) systems; the militarisation of outer space; and the technological development as a transversal factor in a full operating spectrum.

On the other hand, the report also underlines the exploitation opportunities in this environment for the Armed Forces such as technological innovation, internal and international cooperation initiatives and the ability to understand the situation, which will allow us to prevent conflicts or to react and resolve them efficiently. The main sources of strength will be the cooperation within NATO and the security pillar of the EU.

The second section provides the Operational Scenarios (OS) for the Armed Forces during the next decade. The Armed Forces will continue to protect national security interests. It is therefore predicted that in 2035 such interests will be similar to those of today, namely those relating to national sovereignty, those linked to achieving a stable international order in peace, security and respect for human rights, and finally those that affect the safety, well-being and prosperity of the citizens. The current COVID-19 pandemic has clearly shown that the Armed Forces are one of the most useful and resilient tools to face such a global crisis, both inside and outside our borders.

The third section concludes how the Armed Forces should successfully perform in meeting those challenges and threats by 2035: agility, feasibility, sustainability, efficiency, flexibility, a strong information management capability, credibility and resilience, strategic mobility and interoperability have been identified as the most desirable characteristics.

Photo: Ministerio de Defensa

PIZARRO Infantry Fighting Vehicle of the Spanish Army

The Spanish Armed Forces must achieve a balanced application of innovative changes in order to become an agile, flexible, and adaptive force for the future.

This section also shows a set of changes that have been identified as priorities to be implemented: improving strategic agility, reducing the logistical footprint, optimising the costs of operations, improving knowledge and talent management, committing to technological superiority, upgrading capabilities in cyberspace, cognitive domain and outer space, enhancing interoperability with state and non-state actors and, finally, designing organisational and structural improvements.

The key word 'agility' showed up as an outcome when the DOTMLPF-I (doctrine, organisation, training, materiel, leadership and education, personnel, facilities and interoperability) approach was taken to identify the main characteristics that the Spanish Armed Forces should have in 2035.

Due to the rapid evolution of societies and technologies, a strengthened relation with civil authorities, as well as the digital transformation, are essential to lead us to 'Structural Agility'. On the battlefield, our forces need 'Operational Agility' to understand the scenario where they act or are going to act, through a rational intel-cycle where all services work together to provide the right information, and at the right time in order to make rapid decisions which should be followed by a credible force to deter or act when needed, and to maintain an influence in support of the strategic lines of effort. This decision-making process has to be incorporated at all hierarchical levels.

To achieve operational agility, we should be more agile in incorporating and managing new capacities. The speed of technological evolution demands a huge effort to provide affordable solutions from our national industry. In this sense, international cooperation is a must.

Finally, the Spanish Armed Forces are committed to the necessity of shaping those who will be part of us in the years to come: 'Human Resources Agile Management'. Recognising that automatisation will relieve humans from a huge amount of current activities, it is also a reality that future soldiers will need to be prepared to deal with technologies that are still unknown today.

The Spanish Armed Forces have opted to renew themselves, to keep up with present and future demands, so that in 2035 we will continue being a solid contributor to national security and international stability. The next milestone is this year's approval of the National Military Strategy, called 'Concept of Employment of the Armed Forces (CEFAS 21)'.

The Spanish Military Strategy

According to our National Defence Doctrine, the political guidance contained in the DDN and the DPD has to be translated into a military strategy through the so-called Concept of Employment of the Armed Forces (CEFAS 21). This basically defines how the Armed Forces will accomplish their mission within a particular strategic scenario. As I write these lines, the Spanish Joint Staff finds itself in the final phase of defining the CEFAS 21 which will set the foundations for the subsequent Force and Operational Planning for this new planning cycle.

It is not easy to summarise in a few pages how we have faced the challenge of creating a military strategy model that could at the same time comply with the political guidance and be able to tackle the complex strategic scenario around our borders. But I can at least say that we were very clear on three of the features we would definitely like to see in this construct: interconnectivity, pragmatism and alignment.

Interconnectivity tries to ensure that all strategic-military processes of the Spanish Armed Forces are designed in such a way that they can be perfectly coupled with those of the rest of the Administration and the international community in a two-fold approach. On the one hand, interconnectivity is about using a common terminology to facilitate mutual understanding and, on the other hand, it implies developing strategic lines of action that can be seen as "plug and play" by the rest of the ministries and by our allies and partners.

Pragmatism in turn, aims at developing a military strategy that can really define how the Spanish Armed Forces plan and carry out their missions and operations, avoiding an academic model disconnected from reality or from the day-to-day routine.

Alignment between the planning processes of NATO and the EU with our own process is essential to achieve our common objectives and to maintain the interoperability of the armed forces of our allies.

CEFAS 21 Model

Something we have maintained from previous planning cycles is the idea of defining different Strategic Lines of Action to achieve the strategic military objectives. However, this time we have selected some that foster coherence between our military strategy and the concepts developed within the main international security and defence organisations to which Spain belongs.

With that in mind, we have come up with the following three Strategic Lines of Action:

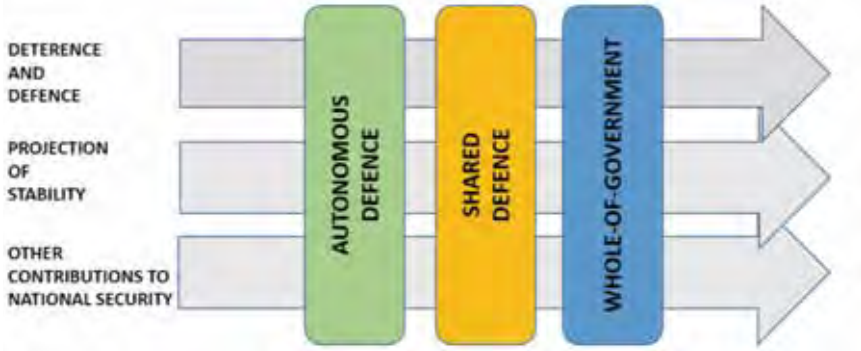
- Deterrence and defence;
- Projection of stability;
- Other contributions to national security.

Admittedly, this decomposition of the activities of the Armed Forces is somehow artificial as the three Strategic Lines of Action are in reality intertwined with each other; still and for practical reasons, there is merit in considering them separately. What is important, however, is the fact that the three altogether completely cover the missions assigned to the Armed Forces by the Spanish Constitution and the National Defence Law, while using a similar structure, concepts and language to those we have developed together with our allies and partners to fight the threats and challenges posed by the current strategic context. This relates especially to those derived from the great power competition, international terrorism and other risks that are not necessarily of a defence nature but where the Armed Forces can provide a valuable contribution.

In order to achieve the desired connectivity, each of these Strategic Lines of Action are defined across three different strategic scenarios:

- Autonomous defence;
- Shared defence;
- Whole-of-government.

As a result, the paradigm of Spain's military strategy contained within CEFAS 21, is defined by the matrix shown in the graphic below (Figure 1).



Military strategy objectives

Photo: MCCE

The Spanish Joint Cyberspace Command (MCCE) is responsible for the planning, management, coordination, control and execution of operations to ensure the armed forces' freedom to act in the cyberspace field. MCCE ensures CHOD's authority over the Defence Comprehensive Information Infrastructure (I3D).

This basically illustrates how each of the three Strategic Lines of Action has implications for the national defence, for our participation in the international community and for our relations with the rest of the Spanish Administration, yet all of them constitute part of the same strategic process facilitating overall coherence.

We can see some of the benefits of this approach by examining what it means for each of them.

Deterrence and Defence

As stated before, Spain's collective defence rests mainly on NATO which implies an important effort to assume contribution responsibilities to its Command and Force Structures, the NATO Response Force (NRF), the Assurance Measures, the missions and operations, etc. At the same time, the Spanish Armed Forces are there to safeguard deterrence and defence against non-shared threats and, considering the existence of a single set of forces at national level, the immediate benefit of having both dimensions - national and international - under the same heading, can be easily inferred.

Furthermore, important synergies can be obtained between national and allied activities during peacetime as most of them - intelligence, indications and warnings, surveillance, exercises - can be oriented towards both autonomous and shared defence at the same time, from the moment of their initial planning and during their execution. This approach provides unquestionable political, military and financial efficiencies.

Additionally, in a context dominated by the proliferation of hybrid threats, it is extremely important to have the whole of government connected to both autonomous and shared defence scenarios. Indeed, deterrence and defence cannot be achieved without an effective national crisis response system and a real interagency resilience approach that must include the necessary coordination to deal with certain crosscutting issues such as cyber-attacks or the protection of critical infrastructures, to name a few.

Projection of Stability

The violent wave of international terrorism that has spread within and around our borders during the last decade has generated a great deal of activity oriented both to fight the threat and address its root causes. The same can be said about other criminal activities like piracy, human trafficking and weapons smuggling that have contributed to the creation of a wide range of instability, especially in the southern part of our periphery.

In this case, the need to incorporate the three scenarios: autonomous defence, shared defence and whole-of-government under the same process, is even more evident and important. Projection of stability entails different types of response, ranging

Photo: Ministerio de Defensa

Spain is set to receive new EUROFIGHTER combat aircraft to augment its existing fleet and to begin the process of replacing its Boeing EF-18 HORNET fleet.

Photo: Ministerio de Defensa

Spanish soldiers undergoing specialist training in a simulated urban environment

from simple Cooperative Security activities to more sophisticated forms of Defence Capacity Building and all the way up to medium-intensity military operations to neutralise powerful terrorist organisations. All these need to be taken on nationally and internationally, including the creation of ad-hoc coalitions and a high degree of civil-military cooperation that together demand the transversal type of approach that CEFAS 21 tries to exploit.

This is exactly the idea under the C-VEO (Counter Violent Extremist Organisations) initiatives that try to obtain maximum synergies of the efforts carried out by all the national, international, civil and military stakeholders across the globe involved in the fight against these types of threats.

Other Contributions to National Security

The Spanish Armed Forces have a long-standing tradition of supporting civil authorities. The Military Emergencies Unit has been instrumental in this regard, having become an extraordinary tool to support our citizens in the event of natural disasters and calamities. More recently, the COVID-19 pandemic has shown that the Armed Forces can provide other types of support in a short period of time and in a very efficient manner.

All these activities are normally taken forward under the whole-of-government approach, but they can acquire an international dimension if any type of support is requested by another nation, as frequently happens.

Even though supporting other civil authorities, whether national or international, is not the main mission of the Armed Forces, nor the most demanding, the experience shows that a proper planning and a dedicated process is essential in order to be in position to provide an expeditious response when required, thus becoming the third and last Strategic Line of Action.

Pragmatism through Strategic Planning

The CEFAS 21's paradigm would not be of much use if it only offered an academic model. This would noy provide real added value and definitely would not be pragmatic. To this effect, we need to ensure that the three Strategic Lines of Action become real processes and change the way the Spanish Armed Forces' activities, missions and operations are planned and executed.

To this end, our Joint Staff has come up with the idea of developing one Strategic Plan for each of the three Strategic Lines of Action, plus one General Strategic Plan to guide the other three and organise those activities, like joint intelligence, surveillance and reconnaissance or cyber defence, that are common to them all.

A Deterrence and Defence Strategic Plan will for instance put our deployments to NATO's enhanced Forward Presence (eFP) in Latvia in the same context as our normal peacetime operations and exercises and our whole-of-government coordination to improve national resilience. All of them would take place without strategic planning anyway, but there is no doubt that a common approach to all of them would definitely improve the coherence and the synergies of our effort.

A General Strategic Plan will in turn allow us to rebalance the priorities among the three Strategic Lines of Action, foster advanced planning and obtain synergies of certain transversal tasks like JISR, thus permitting a more efficient use of some critical enablers.

In summary, CEFAS 21 will allow a new type of approach to our military activity that increases the coherence, flexibility, efficiency and strategic agility, something we consider extremely important in the current strategic context.

Last but not least, we believe that this new concept will also have an intrinsic pedagogical value for all the members of the Spanish Armed Forces as it will transmit the importance of developing an interconnected mentality, where our military strategy is oriented by default to improving our capacity to work with our community of interest, both at a national and international level.

A New Planning Cycle for Spanish Defence

Once CEFAS 21 is approved, the next task is to further refine the planning scenarios to identify and prioritise the capabilities best suited to achieve our objectives. These capabilities are listed in two documents; the OFLP (Long-term Force Objective) and OCM (Military Capabilities Objective). The first shows the capabilities required in the long term (beyond 15 years) taking into account the evolution of the future operational environment (EO 2035), the industrial trends and the emergent and disruptive technologies (EDTs) that are expected to play a major role in that timeframe. Once the OFLP is approved, it is necessary to streamline the procurement activities for the next years in the OCM (3-6 years).

At the beginning of this article, I emphasised how the commonality among the political and strategic perspectives of Spain, NATO and the EU constituted a good starting point to ensure coherence in their capabilities. However, some additional measures are needed to ensure a degree of integration consistent with the "single set of forces" principle. Although the Spanish and NATO/EU cycles are different, eight versus four years, our yearly review gives us the opportunity to include NATO targets or High Impact Capability Goals (HICG) from EU military planning.

Besides our commitment to the EU HICG, we put a great deal of effort in contributing to the defence of Europe through the EU's three main defence initiatives. With regard to PESCO, we are participating in 32 of the 46 current projects. But PESCO commitments go much further than the projects. In spite of our budget constraints, we are the second country in terms of contributions to CSDP missions and operations. With regard to the defence investment, we meet the investment related benchmarks in major equipment and research and technology.

As for the Coordinated Annual Review on Defence (CARD), we are satisfied with our alignment with the focus areas of the last CARD report and, in terms of complying with the principle of the single set of forces.

Within Europe, international cooperation in major equipment projects is yielding fruitful results. We lead two important projects such as the Airborne Electronic Attack and more importantly, the Strategic Command and Control for CSDP missions and operations which aims at providing a state-of-the-art solution to the long-standing problem of command and control measures of the European External Action Service. Furthermore, in the 4th PESCO call we will present the project Essential Elements of European Escorts (E4) which in a few years' time will offer a family of systems based on cutting edge technology that may be incorporated to any European naval platform.

With regard to NATO, we have achieved a similar degree of integration between our national planning and the NATO Defence Planning Process.

It is true that our economic situation, particularly after COVID-19, makes it very difficult for us to reach the Cardiff Pledge by 2024. On the other hand, we meet the 20% benchmark of investment in major equipment.

In general terms, the Spanish commitment to "the Europe that protects" can be checked by the permanent contribution of Spanish forces to EU missions and operations. Moreover, Spain is also one of the most committed allies with NATO deterrence and defence forces. This commitment needs to be based on a coherent planning effort. In this article, you have seen how the decisions on capabilities are consistent with the European vision of our government and how the NATO and EU military planning targets and goals are taken into account to determine the priorities for our weapon systems.

Furthermore, you have also seen how our Armed Forces work simultaneously in the NATO, EU and national planning processes and initiatives to ensure the maximum degree of coherence in the full implementation of Spain of the "single set of forces" principle. We think Spain is a good example of military capabilities planning integration both with NATO and the EU. ■

Spain's Military to Rework its Modernisation Priorities

Photo: DGAM

Spain is in the midst of rejuvenating its Armed Forces. The Spanish procurement authority Dirección General de Armamento y Material (DGAM) is currently conducting 40 armament programmes, some of which are big-ticket acquisitions. ESD had the opportunity to talk to Adm. Santiago Ramón González Gómez, the General Director of DGAM.

ESD: As the central Spanish defence procurement authority, is DGAM the only organisation in charge of responding to the materiel needs of the Spanish military? Are there other organisations involved in defence procurement in Spain?

Adm. González: The responsibility for planning the financial and materiel resources necessary for the functioning of the Spanish Armed Forces lies with the Secretary of State for Defence (SEDEF), to whom the Directorate General for Armament and Materiel (DGAM) reports.

The DGAM is responsible for the procurement process of armaments and its associated materiel, and for the research and development activities related to such materiel. The maintenance of this materiel throughout its life-cycle is the responsibility of the end user, except in the case of dual-use materiel, in which case it is centralised in the DGAM. The procurement processes for the rest of the resources (financial and materiel) necessary for the functioning of the Armed Forces and the Department are planned and managed in the SEDEF directorates and centres associated with these resources (DIGENIN, CESTIC, DIGENECO).

ESD: What effects did the establishment of the Permanent Structured Cooperation pattern (PESCO) have on your organisation's structure and work? What developments are yet to be expected in this context?

Adm. González: The current development of European initiatives such as PESCO and the European Defence Fund (EDF) has had a direct impact on the structure of our organisation. Spain is firmly committed to the European Defence project, as demonstrated by the large number of European initiatives in which our country participates. The establishment of PESCO implies meeting a series of commitments. Some of these commitments, such as the harmonisation of needs, military capabilities and industrial cooperation within the framework of the European Defence Agency (EDA), are those that fall mainly within the scope of the DGAM.

In this regard, the DGAM has been adapting its structures and organisation to efficiently attend to the various PESCO initiatives and activities. Currently, staff from different DGAM directorates are actively and constantly involved in various working groups in connection with PESCO projects, plans and programmes. As a result of this participation, the DGAM has developed an internal procedure, fully implemented in 2020, for sharing information and evaluating and managing PESCO, European Defence Industrial Development Programme (EDIDP) and EDF projects.

Where PESCO projects are concerned, Spain will continue to participate actively in this initiative. Spain is currently coordinating two projects ("Strategic C2 system for CSDP missions and operations" from the first wave and "Airborne Electronic Attack (AEA)" from the third wave of projects). Spain also participates in a further 22 projects and is an observer in 10 more projects led by other countries.

Photo: Navantia

Providing Spain's homeland with a defence for evolving threats and equipped with the latest digital technology, the F-110 programme will further protect the country and its citizens.

Photo: GDELS

Spain has placed a €1.74Bn contract to procure 348 8x8 DRAGÓN VCR wheeles combat vehicles.

The National Implementation Plan 2021, the new call for PESCO projects and the workshop on collaborative opportunities are some examples of the developments we are currently working on in this field.

ESD: We understand that DGAM is also the MoD's centre of excellence for Research & Development (R&D) Programmes? In terms of budget allocations, what is the share assigned to R&D? Can you provide a brief survey of your current R&D activities?

Adm. González: The planned R&D expenditure in the Ministry of Defence's 2021 budget is €58.8M, which represents 2.22 per cent of the budget allocated to materiel procurement. With reference to the current RDI activities carried out by the DGAM, these can be divided into two main areas: national activities and transnational cooperation activities, most of them under the umbrella of the European Defence Action Plan (EDAP).

Within the framework of cooperative Research, Development, and Innovation (RDI) activities at European level, Spain has actively participated in the (EDIDP). In 2019, the European Commission (EC) received a total of 40 proposals, 18 of which were selected for co-funding. Spain participates in 15 of the selected industrial consortia, four of which are led by national entities. In the 2020 call, the Spanish Ministry of Defence sponsors 29 proposals, 11 of which are coordinated by Spanish entities.

Regarding national RDI activities, earlier this year the Secretary of State for Defence approved a new research and technology strategy that will boost the Ministry of Defence's RDI investments in the years to come. This strategy prioritises some strategic objectives with regard to the development of sophisticated and complex weapon systems (aircraft, ships, satellites, etc.), as well as others that target specific technological challenges, in areas such as cyber defence, electronic warfare, com-

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Photo: Airbus Helicopters

Under the OCCAR-EA TIGER Programme, Spain received its first TIGER HAD/E Helicopters in 2014.

munications, the fight against asymmetric threats, the use of civilian technology for military purposes (AI, materials, robotics, small satellites, etc.), digital transformation and sustainable energy, among others.

ESD: What is the total annual budget available for defence procurement in Spain? What is the share of the procurement budget if compared to the entire defence budget or even the Spanish GNP?
Adm. González: Around 22 per cent of Spain's total defence expenditure, some €3.2Bn, is allocated to defence procurement.

ESD: What are the most important defence programmes currently executed by your organisation?
Adm. González: The DGAM is currently managing 40 armament programmes. In terms of economic and technological relevance, the programmes concerning the 8x8 DRAGÓN combat vehicle, the S-80 submarines and the F-110 frigates are worth mentioning.
In terms of RDI, the most important programme is the Next Generation Weapon System (NGWS) within the concept of the Future Combat Air System (FCAS).
This international initiative in which Spain participates together with France and Germany aims not only to form the backbone of our Air Forces from 2040 onwards, replacing the fourth-generation fighters currently inherited in the fleets – the EUROFIGHTER and the RAFALE – but also to promote the aeronautics and defence industry as one of the main contributors to the common European defence.
In connection with ongoing land force modernisation programmes, the Spanish Army has drawn up the Integrated Brigade Combat System Plan (SCI-BRI). The plan defines different types of Army brigades, in addition to the Marine Infantry brigade, integrating all the necessary combat capabilities at brigade level to successfully face future scenarios and fields of action envisaged in Horizon 2035.

ESD: Which of your current programmes are carried out in international partnerships with other national or multinational procurement organisations? Are there defence procurement efforts executed in the scope of public-private partnerships?
Adm. González: We consider our participation in OCCAR (Organisation for Joint Armament Cooperation) and EDF to be the priority options for participation in European projects and programmes.
Spain, like other countries, is a significant contributor to the following OCCAR programmes: the TIGER combat helicopter, A400M transport aircraft, EuroMALE remotely piloted air system and European Secure Software Defined Radio (ESSOR).
Under the auspices of NATO, NETMA (NATO Eurofighter and Tornado Management Agency) manages the predecessor of the NGWS, the EF-2000 Eurofighter Programme, while NAHEMA (NATO Helicopter Management Agency) manages the NH-90 Programme. Based on the experience of these programmes, an ad hoc organisation has been created in Paris, the Combined Project Team (CPT), with the mandate to manage the NGWS programme, at least in the initial phases, although the long-term plan is to transfer it to OCCAR, as it is already covered by the NGWS international foundation agreement, within the FCAS Framework Agreement.
Regarding EDF support, Spain participates in 13 of the projects selected by the EC in the EDIDP 2019 call, leading four of them, and has chosen EDA as Programme Management Office for two projects (ECYSAP and ESC2) and OCCAR to manage the other two (OPTISSE (Optical Payload) and REACT (AEA)). For future EDF calls, Spain's position regarding EDA and OCCAR will remain unchanged in both the short and medium term.

ESD: The DRAGÓN is certainly among your current lighthouse projects. What is the current status of the programme, and has a decision been made regarding the vehicle's main armament, especially the turret? How many versions of the vehicle are to be introduced?
Adm. González: The initial design of the 8x8 combat vehicle is currently being agreed on so that series production can begin next year. Tess, as the company awarded the production contract, will make the final decision on the main gun turret to be mounted on the vehicle by the end of the first half of this year. The first production tranche comprises five versions: infantry fighting vehicle, cavalry scout vehicle, battalion command post vehicle, sapper fighting vehicle and forward observation vehicle.

ESD: How is the F-110 programme coming along? Do you envision serious export potential for this design?
Adm. González: Upon completion of the definition of the ships and the selection of the main equipment of the ship, the Execution Phase of the Programme started on 23 April 2019, upon the signing of the Design and Construction Execution Order with NAVANTIA. In relation to the equipment contemplated in the Execution Order, more than half of the contracts envisaged have been formalised; contracts that represent 85 per cent of the budget allocated to this item.
The preliminary design review will be carried out shortly (second half of May), and the critical design review (CDR) will be carried out 14 months later. Both design reviews will be unique to the series of five ships to be built for the Navy, with the construction of the first frigate (F-111) starting immediately after the CDR.
The planned delivery schedule is one frigate per year starting in 2027.
In order for export to be successful, the competitiveness of NAVANTIA's products is crucial, and the Defence/Navy–NAVANTIA collaboration model is one of the pillars on which to build this competitiveness. In this environment, the F-110 frigate programme is key to the modernisation of the Navy's fleet, to secure NAVANTIA's future in the export of this type of products, continuing along the same path started on by the F-100 frigates and, above all, acting as

the driving force that will take the Spanish Naval sector to Industry 4.0 excellence.

ESD: In light of such technologically demanding requirements like EuroMALE and FCAS, to what extent is the Spanish defence industrial base capable of responding to the materiel requirements of the Spanish Armed Forces? In which areas do you have to rely on foreign contractors?

Adm. González: Spain decided to join the highly selective club of nations with a vocation for the design, development and production of highly complex weapon systems, thus ceasing to be a mere consumer. This decision has implied a major effort by the Spanish defence industry in the field of innovation, process improvement, etc., supported by the Spanish Government. The Spanish defence industrial base has the necessary technical and industrial skills to enable the design, development and integration of complete weapon systems.

The best example of our capability to participate in this type of project was the recognition of our partners in the NGWS programme when we entered into negotiations and expressed our ambition to participate at the same level as the rest of the interested parties. Taking this decision gave rise to a huge qualitative leap for the Spanish Defence Industry, and the intention to maintain the pace of improvement is one of the key guidelines in the Spanish Ministry of Defence.

EuroMALE is a collaborative project in which the participating industries work together, developing an agreement that has enabled a shared working scheme towards the fulfilment of a common objective to be defined. This system will underpin the execution of stage 2 of the EuroMALE contract covering the development, production and initial 5-year support of the system, which is expected to be signed this year.

In an increasingly globalised world, further European and transatlantic integration is irrevocable. The development of increasingly complex weapon systems, based on the system-of-systems concept, makes it virtually impossible for any single nation to have the market influence and the technological and purchasing capability to fully cover the entire design.

Institutional commitment to Spanish defence companies, characterised by their high technological and innovative level, is a key line of action for the DGAM. The defence industrial sector is a basic strategic element for national defence and security, contributing to the economic activity of our country and to the creation of employment, especially highly qualified employment.

The interview was conducted by Esteban Villarejo.

Photo: Navirís (Fincantieri / Naval Group)

Spain has joined the European Patrol Corvette (EPC) programme to develop a prototype of a modular 3,300-tonne ship responsible for a number of tasks and missions, including those performed by offshore patrol vessels and light frigates. Depicted is an official design rendering of the EPC PESCO project.

Spanish Defence after COVID: The Industry Speaks

Esteban Villarejo

FCAS, new F-110 frigates and 8x8 armoured vehicles are at the forefront of Spain's defence plans for the remainder of this decade. However, Spain's defence association, TEDAE, is calling for "effective measures to curb the effects of the pandemic to enable us to continue developing the technological programmes".

According to data from the Spanish Defence Industry Association, TEDAE, Spain's defence industry turnover was €7.1Bn in 2019 and employed 94,547 professionals in 359 companies. The breakdown of TEDAE's industry turnover per sector was military aviation with €4.9Bn (35.1%), naval defence with €1.3Bn (9.7%), ground defence with €0.66Bn (4.7%), and military space €0.17Bn (1.2%). Most of this is shared amongst a number of international consortia involving companies from other countries, including Germany, France, Italy and the UK and on programmes such as the EUROFIGHTER, the EJ2000 engine for the EUROFIGHTER, the A400M aircraft, the NH-90 helicopter and the MTR390 engine for the TIGER combat helicopter.

Photo: Navantia

Navantia launches the third corvette for the Royal Saudi Navy at its facilities in San Fernando (Cádiz).

Main Programmes

After more than a year of the COVID-19 pandemic, the defence sector is at a crossroads, as is the case with the entire economic recovery efforts in Spain and the European Union as a whole. But the pillars underpinning the defence sector are solid. These were established over the last four years to boost the defence industry in a new planning cycle with a number of important programmes. These include: (1) The Next Generation Weapon System (NGWS)/Future Combat Air System (FCAS) future European fighter programme; (2) the expectations that the Spanish Air Force might replace its 85 F-18 HORNET jets with new EUROFIGHTER aircraft; (3) the final launch of the future 8×8 armoured fighting vehicle DRAGÓN; (4) five new F-110 frigates; (5) four new S-80 class submarines; (6) the second phase of the NH-90 multirole helicopter; (7) and a Joint Tactical Radio System which will guarantee the technological sovereignty and autonomy of the Spanish Armed Forces. These programmes represent the most important amongst a number of others still to come.

In total, the Spanish MoD is currently developing 27 weapon systems and materiel programmes. Companies such as Airbus DS, Navantia, Indra, Santa Bárbara Sistemas-General Dynamics European Land Systems (SBS-GDELS), Airbus Helicopters, Expal, Sapa, Urovesa, Escribano, Grupo Oesía, Thales España, ITP Aero, Hisdesat, GMV, Sener or Instalaza all have a consolidated presence in the Spanish defence programmes or other exports.

In a recent study on the impact of COVID-19 on the defence industry base prepared by the MoD, it was noted that the sector is showing its resilience in the face of these adverse circumstances. It has adapted to teleworking and has readapted its manufacturing processes to collaborate with the provision of materials and protective equipment.

TEDAE, the Defence Industry Association

"In terms of challenges, it is of prime importance that the Spanish defence sector continues to grow. Our prominent position on the European map must be consolidated with actions so that Europe continues to consider Spain as a benchmark for major projects. We are currently involved in important technological programmes that represent a qualitative leap of extraordinary importance at the European level. For this reason, it is necessary that we contribute to their development and that we are able to maintain our competitiveness in relation to our European neighbours. In this context, it is even more necessary to maximise the benefits of all the investments we are making in technology, human resources and other capabilities", Ricardo Martí, President of TEDAE, told ESD.

Investment in R&D and innovation is essential. According to a KPMG report for TEDAE, the companies of this association directly invest more than €1.120M in R&D and more than €700M in defence, highlighting how the defence sector as a whole has become one of the main drivers of innovation in Spain.

What measures need to be taken to boost the industry in Spain? "Defence is a sector that boosts the economy and is key to recov-

Photo: Esteban Villarejo

The new DRAGÓN 8x8 AFV is currently subject to field tests.

ery after the crisis. In the short term, we need effective measures to curb the effects of the pandemic and to enable us to continue developing the technological programmes in which we are currently engaged. In the medium and long term, TEDAE considers it essential to develop strategic plans with a long-term vision that guarantee the continuity of policies and the development of new programmes. The sector needs an industrial policy that enables us to maintain our international leadership as well as the productive capacities of companies, and their value chain, whilst preserving our quality employment", the President of TEDAE underlined.

The Spanish defence industry also relies on new EU funds to promote defence initiatives after the COVID-19 crisis ends. One positive example is that a European Defence Fund has been created at the European level. This European Union instrument, endowed with €8Bn for the next seven years, will allow for the promotion of European cooperation in the area of defence R&D.

ESD asked leaders of Spanish defence companies how they perceived the current situation and the opportunities in the coming years after the COVID pandemic:

Alberto Gutiérrez, Head of Military Aircraft (Airbus Defence & Space) and Head of Airbus Spain

Airbus Spain is the driving force for Spanish industry. European collaboration and support continues to offer the greatest opportunity to do more with less while protecting sovereignty and providing us with an opportunity for growth and development and the building up of skills, capabilities and technologies.

We have made progress on a number of projects which are of critical importance for Europe's strategic autonomy. On FCAS, following the official signature of the Spanish industry's contracts, all three partner nations (France, Germany and Spain) are progressing towards a formal cooperation agreement.

The 18-month Joint Concept Study and Phase 1A of the demonstrator portion are progressing too. The goal for 2021 is for FCAS to enter the preliminary demonstrator development phase for the next-generation fighter and the remote carriers. With regards to Eurodrone, we have continued negotiations with OCCAR, while achieving all nine A400M deliveries for 2020, despite COVID challenges, with nine aircraft delivered. With the first deliveries to Luxembourg and Belgium, all launch nations have now received at least one A400M.

FCAS and Eurodrone are two priority defence programmes for Airbus and a stepping stone towards greater European collaboration and an enabler of stronger, more strategic sovereign European defence capability.

At the national level, we are working closely with customers on several programmes focused on modernising and enhancing the Spanish Air Force's capabilities through the acquisition of tanker and C295 Maritime Patrol aircraft, as well as a replacement for Spain's legacy F-18 fleet in the Canary Islands, an operational priority.

But perhaps the most novel of all projects is the Advanced Flex-Jet Trainer, presented as a concept in late 2020 to meet the future needs of the Spanish Air Force.

Photo: Esteban Villarejo

At its shipyard in Cartagena, Navantia is working on the new S-81 submarine for the Spanish Navy.

Gonzalo Mateo-Guerrero, Chief Operating Officer Navantia

Currently, Navantia is carrying out several projects at the different company sites and are currently in the process of completing the second AOR for the Australian Navy. In addition, Navantia is building five frigates and four submarines for the Spanish Navy. The first of those submarines was launched last April.

Furthermore, Navantia is currently conducting an ambitious project that comprises the construction of five corvettes for the Royal Saudi Navy – two of which are already afloat – while implementing an extensive training programme for the crew members and maintenance groups, as well as the creation of onsite infrastructure for the maintenance of their vessels and delivery of life-cycle support.

There are several potential international projects on the table right now, such as the construction of Landing Platform/Dock (LPD) vessels for the Kingdom of Saudi Arabia, patrol boats for Morocco, as well as the construction of an offshore patrol vessel (OPV) for the Spanish Navy, which is still in its preliminary stage.

The Spanish military industry is strong at the moment. We have good prospects with the export of submarines with AIP (air independent propulsion) technology, frigates and offshore patrol vessels. In addition, the collaboration among the different European military shipyards opens up new opportunities both in the domestic (European market) and internationally.

José Manuel Fernández Bosch, CEO of EXPAL Systems

In EXPAL's area of specialisation in ammunition, our Extended Range 155 mm family, which recently entered into service with the Spanish Army, has also led us to open up to exporting to several countries. This is a national product that EXPAL will continue to develop and as part of it, we are supporting the Spanish Army and the DGAM in the selection and integration of a precision guidance kit for a 155 mm Extended Range projectile.

We have also recently started the development of a guidance kit for 120 mm projectiles, scalable to 155 mm, through the COINCIDENTE Programme to respond to the Army's equipment needs within the 'FUERZA 35' project.

We are also moving forward into the systems market, with our Dual-EIMOS 81 mm platform onboard mortar system as a good example. This development is in the final stages to be a chosen vehicle for the Marine Corps with deep fording capabilities and greater versatility, fulfilling the Army's operational requirements.

Photo: Airbus DS

Airbus facility in Getafe (Madrid). Hangar for the MRTT transformation

Photo: Escribano

Spanish pavilion at the IDEX defence exhibition in Abu Dhabi

While EXPAL has a very strong focus on ammunition, guidance systems are becoming very important to us. We are working on projects to ensure the precision of the projectiles using course correction fuses (CCF), both internally and with international partners. We are following the same approach as for our mortar ammunition, by integrating guidance kits that allow for increasing the precision of the ammunition and its use with greater efficiency. This applies to both land, naval and air artillery ammunition.

Another important line of opportunities for EXPAL – using our depth of experience in energetic materials – is the rockets and missiles propulsion field. With rockets, we are working on the CAT 70 at the request of a NATO country. In Ammunition and Artillery Rocket Launcher Systems, we are committed to leading a Spanish solution that allows the Army to take over this capacity in the short term, with the development of an MLRS, a rocket launcher on a mobile truck platform.

Following the development of a differentiated naval artillery portfolio, I would like to highlight the production of advanced EXPAL 127 mm illuminating projectiles for the German Navy, carried out through a contract with our German partner, Diehl.

Luis Furnells, President of Tecnobit-Grupo Oesía

The Spanish defence industry must respond to the enormous challenges that lie ahead for society, and support steps towards the clear common objective: to promote economic reactivation and contribute, as we have always done, to promoting the transformation of our economy through technological development and, with this, to the recovery and sustainable growth of our country.

In light of these goals, the Spanish defence industry is undoubtedly a strategic sector and a model in terms of public-private collaboration, technological development, often with dual application of our technologies, the export of our products and the generation of stable qualified employment. All this will be possible if the industry can operate with the certainty to develop and be able to deploy its full potential in the future, with industry support schemes that facilitate its development.

We hope to contribute our technology to other future programmes, both European, such as the European MALE and national, such as the AFJT and SIRTAP.

In recent years, we have expanded our capabilities in the Space sector and we also want to continue growing in the so-called 'New sSpace' industry.

The company has just completed its first simulation contract for the United Arab Emirates, with which we will provide the United Arab Emirates' Armed Forces with hitherto unknown capability, thanks to the new virtual simulator, designed to train an artillery battalion and prepare them to join the manoeuvres unit and reach brigade level.

This adds to the existing demand in the United States, Europe, Japan and Latin America. Our technological projects in the security, defence and aeronautics field are potential recipients of European funds, as these technologies are also often dual-use and contribute to activating operations and territorial cohesion.

José Sarnito, Head of Defence Thales España

We are currently participating in the demonstrator of the new 8x8 vehicle for the Army. Our capabilities in command and control and in radio communications allow us to participate as a technical solution expert.

In the field of radio communications, we are closely working with Indra, our partner for the SCRT programme, a very challenging project for modernising the communications of the Armed Forces according to the new Software Defined Radios and the ESSOR programme.

We are also continuously working with the Army aligned with the Force 2035 Experimentation Plan, where Thales is offering communications solutions and systems to meet the present and future needs of command capabilities.

In the Space sector, Thales Alenia Space has a key role in the SPAINSAT NG programme, that successfully passed Preliminary Design Review (PDR) in October, an important milestone achieved on schedule despite COVID-19. Spanish industry assumes leadership of a communications payload for the first time, including integration of both satellites' payloads in Spain, with advanced technologies for next generation secure communications satellites.

The General Directorate for Armament and Material (DGAM) and the naval shipyard Navantia selected Thales Technologies for the Spanish Navy's five new multi-mission frigates (F-110 programme). The vessels' anti-

submarine warfare (ASW) capability, based on two world-class sonars, the CAPTAS 4 Compact and the BlueMaster, and the BlueScan digital acoustic system, will be integrated through Navantia Combat Management System SCOMBA F110 and will enable the service to conduct maritime surveillance, search and protection missions in any theatre of operations.
Regarding our projects abroad, we continue working on our command and control solutions for the Swiss Army in cooperation with Thales Switzerland. In Asia and Africa, our Horus Shield suite is used by different countries for anti-drone missions.

Photo: Navantia

The S-81 submarine under construction

Carlos Alzola, CEO of ITP AERO

ITP Aero is the Spanish representative in the Europrop International (EPI), Eurojet and MTRI consortia, participating in the development, production, service support and maintenance of the TP400, EJ200 and MTR390-E engines for the A400M and EUROFIGHTER aircraft and the TIGER-HAD helicopter. ITP Aero also participates in the NH-90 helicopter programme through the assembly and maintenance of GE Aviation's CT7-8F5 engine.
ITP Aero is leading the engine technology pillar of the NGWS (Next Generation Weapon System) programme within the FCAS (Future Combat Air System) programme in Spain, a key project for the development of European defence technologies and capabilities for the coming decades and which will entail a highly relevant investment in technology.
The Spanish defence industry is in the midst of offering relevant new opportunities for companies, such as ITP Aero, that contribute and support safer and more technologically advanced defence capabilities. A clear example of ITP Aero's support to the Spanish Armed Forces is the framework contract signed in 2020 under which ITP Aero is responsible for the maintenance of airplane and helicopter in-service engines of the Spanish Air Force, Spanish Army and Spanish Navy.
It is necessary to promote the development of new defence programmes such as the NGWS-FCAS, which will involve major investments in critical technological capabilities for national security and which will also enable the transfer of knowledge from the military field to the civilian sphere. In terms of new programmes, it is also worth mentioning the development of the Eurodrone, a key project for Spain's Air Force, which will entail state-of-the-art technology, investments, and will provide key new capabilities for national security.

Photo: author

The King of Spain visiting the new campus of Airbus Defence and Space in Getafe

Ángel Escribano, President of Escribano Mechanical & Engineering (EME)

The defence industry sector in Spain is trained to be able to offer and equip our Armed Forces with the most advanced technology. However, international competitiveness is increasing and the effort of the industry is necessary, cooperating jointly, as well as the support of our authorities to maintain and promote the strategic industrial capacities of the sector, as well as the creation and promotion of new technologies. After the difficult situation experienced with COVID, and which we continue to face today, it is important that Spain, supported by European cooperation initiatives, appeals for unity and ensures the critical industrial technological capabilities necessary to respond to a crisis of any kind. It is also necessary to provide our Armed Forces with reliable and cutting-edge systems and solutions, to protect our soldiers in their missions and to be an international benchmark for defence technology in the future.
We are aware that together we can do more, and that is why our authorities, the Armed Forces and the national defence industry are working together on new challenges and also on challenges posed by the current defence paradigm. The development of the future combat vehicle VCR DRAGÓN 8x8 for our Army is an example. We believe that a great effort is being made to strengthen the productive and technological value chain and the consolidation of alliances between companies is being promoted.
Escribano, as part of the national defence industry, will be assisting with our resources, production and technological capacities to project our country to the forefront of technological advances. ■

Protecting Critical Infrastructure – Cyber or Sabotage

Tony Kingham

This article looks at one of the most pressing threats to critical national infrastructure.

On 10 April 2021, the heavily guarded Natanz nuclear plant, Iran's main uranium enrichment facility and part of the country's critical national infrastructure (CNI), was the target of a cyber-attack, which the Iranians claim was an act of sabotage carried out by Israel. Nobody seems to dispute that it was the Israelis, least of all the Israelis themselves. According to reports in the New York Times, an explosion destroyed an independently protected power supply, which damaged the centrifuges.

The intriguing aspect about this particular attack is that one would assume that such a high-profile target, currently at the centre of a global geopolitical controversy, would be safely tucked away behind an air gap between its supervisory control and data acquisition (SCADA) and any external networks. In addition, electronic memory devices of any kind, capable of introducing malware to the system, would be strictly banned from the facility and its independent power supply, with all the necessary measures in place to enforce such a ban. After all, the Iranians are not new to cyber-attacks.

In 2010, they were the target of the computer worm Stuxnet, which reportedly destroyed 984 centrifuges at Natanz and other facilities, by causing them to burn themselves out. The facility was not connected to the internet and the worm was introduced to the system via a USB connection, or in other words, by a saboteur. On that occasion, the finger was pointed at Israel, and at the US as well. This first attack obviously constituted a huge embarrassment for the Iranians and was a major wake-up call. But as well as a threat, the Iranians realised that cyber warfare offered an incredibly powerful game-changing method of asymmetric warfare, creating a level playing field with regional and global powers, and carrying a very low risk of things escalating into an actual shooting war.

Consequently, from 2010, Iran began to invest a considerable amount of time, money and energy in developing their own cyber capability in the form of an organisation called "The Cyber Defense Command". Iran is now considered a major emerging power in the field of cyber warfare.

In 2012, Iranian hackers targeted several big American banks including JPMorgan Chase, Bank of America and Capital One. They flooded the banks' computer networks with traffic, knocking them offline and incurring millions of dollars in lost business. In 2014, an Israeli official told a press conference that Iran had launched numerous significant attacks against Israel's internet infrastructure. In Turkey in 2015, a massive power outage occurred, lasting 12 hours in 44 of Turkey's 81 provinces, af-

Photo: PixaHive

Author

Tony Kingham is the Editor of Border Security Report magazine and a Director of the World Border Security Congress and the International Association of Critical Infrastructure Protection Professionals (IACIPP).

EVPÚ Defence Introduces New Weapon Stations

Czech electro-optical equipment manufacturer EVPU Defence is planning to focus their IDET 21 exhibition on its specialised products including remote-controlled weapon stations (RCWS). The EVPU Defence RCWS are designed for enhanced perimeter surveillance, tracking, targeting and fire control. The turnkey defence solutions provider currently offers two types of RWCS suitable for land and naval applications – with plans to expand its portfolio in the near future, according to sources at EVPU Defence.

RCWS 12, the larger of the two systems, is a device based on a modular concept. Its standard version is capable of being fitted with a 7.62 mm to 12.7 mm NATO or Russian calibre machine gun and 30 mm – 40 mm grenade launchers. Available modifications include the integration of SPIKE guided anti-tank missiles or adjusting the system to carry two weapons at the same time. On the other hand, ZSRD-07 is a lighter and more compact product designed for 5.56 mm – 7.62 mm machine guns.

Both of these remote-controlled weapon stations use a high-quality electro-optical system with a Full HD day camera, high-resolution thermal imaging camera, laser rangefinder and an optional aiming camera. They also both share two all-important features: a tradition of use within the NATO forces and maximum adaptability to suit the requirements of a specific application.

A close-up view of the CWS 12

Photos: EVPU Defence

THE ZSRD-07 RCWS is designed to integrate 5.56 mm and 7.62 mm machine guns.

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fecting 40 million people. In June 2017, the UK's Daily Telegraph newspaper reported that intelligence officials concluded that Iran was responsible for a cyberattack carried out on the British Parliament, lasting 12 hours and compromising roughly 90 email accounts belonging to MPs. In 2018, a ransomware attack crippled the city of Atlanta. Once again, Iran was blamed.

So, given their bitter experience and hard-won expertise in this area, it seems surprising that Iran has been caught out again and in the same manner. Iranian State TV reported that Iran's intelligence services claimed to have identified an individual named Reza Karimi as the saboteur responsible for the attack, alleging that he fled Iran shortly before the blast. Assuming that the Iranians have continued to protect their plant by some sort of air gap, another insider being responsible would make sense. But as in all cases of international espionage, the most obvious answers should always be treated with caution. For the Iranians, producing a saboteur shows that the plant was not vulnerable to an external cyber-attack. For the attackers, (whoever they may be) a 'saboteur' fleeing the country at the right time, may put the Iranians off looking for another modus operandi. Perhaps I have been reading too much John le Carré since even with an air gap, there are other possibilities. By spoofing the time, it is possible to disrupt the power flow to CNI systems causing them to burn out. Other possibilities include phishing emails to gain access to the corporate network with malware via staff members' emails. In all likelihood however, we may never know the truth! Of course, it is not just the Iranians and Israelis are engaged in a CNI cyber struggle.

In 2000, a disgruntled employee in Australia hacked into a computerised waste management system in Queensland, causing millions of litres of raw sewage to spill out into local parks, rivers and even the grounds of a Hyatt Regency hotel. In December 2015, hackers compromised SCADA systems of three energy distribution companies in Ukraine and temporarily disrupted the electricity supply to consumers. The Ukrainians said that the attack had come from an IP address inside Russia. In 2017, an unspecified state hacked into systems at a Schneider Electric SE facility in the Middle East causing an emergency shutdown. In February 2021, a hacker accessed the network of a water treatment plant in Florida with the intention of increasing the amount of 'lye' content (a substance used in water purification) in the town's water from 100 parts per million to more than 11,000. This would have been harmful to people if consumed. Fortunately, the hack was spotted and reversed.

It is clear therefore that cyber-attacks are not just the domain of nation states, bad actors from terrorist organisations and organised crime groups, but also include disgruntled employees and lone wolves, all of whom have the potential to cause massive damage and bring down entire systems.

Ways to Protect Critical Infrastructure

The most effective way to protect systems is to physically disconnect from the internet and external devices. Obviously, this is problematic, because if you are operating and maintaining a nationwide system, there may be no other way to communicate, and send and receive data, unless the whole system is independent of the national network. However, in the case of critical sites and systems this may be necessary.

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Where this is not possible, regularly updated and robust firewalls are needed, and since cyber-attacks require two-way communication to pull off an attack, Unidirectional Security Gateways (USG), which is hardware that limits the sending of information in only one direction, is required.

Training

The most vulnerable part of any system is nearly always the people. Staff need to be regularly trained in the dark arts of hackers and their phishing emails, how to spot them and how to avoid them. This applies equally to their personal emails and web habits, because hackers may use their personal lives to coerce employees into acts that they would not otherwise do. Training should therefore also include how to spot potential insider behaviour. Finally, they also need to be trained to have secure passwords.

Insider Threats

Deep background checks and systems like user activity monitoring software, which alerts the administration to any anomalies in the systems should be in place. Staff should only be granted access to the parts of the SCADA system they need to have, and no more. There should be a manual override of the system in place in case the system is hacked. Furthermore, regular penetration tests of all systems and manual overrides should be carried out. Memory devices of all kinds should also be prohibited and technology put in place to detect it.

Photo: PixaHive

US cyberwarfare specialists training at the Warfield Air National Guard Base in Maryland

Conclusion

The attack on the Florida water treatment plant is a vivid illustration of the sort of scenario that many have been predicting for so long. Luckily, an alert colleague spotted the attempt and blocked it before any harm could be done. Had the attack succeeded however, we could have been looking at hundreds, maybe thousands of people being harmed.

However, it is perhaps the Natanz incident that we should really be worrying about the most, even though it was aimed at a so-called rogue state. Whoever the perpetrators were, and whatever method they used to achieve their objective, it is clear that sabotaging Iran's nuclear programme was the aim, not to cause a mass casualty incident.

But the attackers succeeded in penetrating a highly sophisticated security system of a cyber-savvy organisation, and were able to destroy the centrifuges. If one can, others can!

Let us not forget that in 2014, an insider at the Doel-4 nuclear reactor facility drained the lubricant for the reactor turbine, causing it to overheat, resulting in an estimated US$100 - US$200M in damage.

We must assume that at some point our CNI, including nuclear facilities, will be the target of a terrorist or state-sponsored attack. We must therefore learn the lessons of past incidents, from friends and foes alike, and implement the necessary measures to safeguard our CNI. ■

How to Train for the Coming Drone Wars

The Urgent Need for Immersive Training with Extended Reality

John Antal

Warfare is changing, and training is not keeping pace. Recent combat actions in Libya, Syria, and especially in Nagorno-Karabakh in 2020, demonstrated the value of unmanned systems in conducting precision strikes. According to confirmed drone video footage, during the recent 2020 Nagorno-Karabakh War, Azerbaijan destroyed at least 1,021 Armenian military systems with Unmanned Aerial Systems (UAS). These included air defence and electronic warfare systems, tanks, howitzers and trucks. In addition, UAS killed hundreds of troops occupying dug-in positions. Azerbaijan's UAS and loitering munitions were difficult to detect and hard to destroy with traditional air defence systems. This level of destruction by unmanned systems is unprecedented in the history of war. One Armenian soldier explained it this way: "We could not hide, and we could not fight back."
As militaries around the world comprehend the lessons from these recent conflicts, they are scrambling to purchase and field their own UAS precision strike capabilities and Counter Unmanned Aerial Systems (CUAS). New systems alone are not the answer; the solution involves both equipment and training. The urgent requirement to train personnel in both offensive and defensive UAS operations using actual systems is costly and time-consuming. Evolving immersive training technologies, such as Extended Reality (XR), provide an immediate, effective and less expensive training venue.

Photo: Azerbaijan Ministry of Defence video

In the largest drone battle in history, during the 2020 Second Nagorno Karabakh-War, Azerbaijan destroyed Armenian forces and won a decisive victory primarily with unmanned systems.

Author

John Antal is a defence analyst and correspondent who has served as a member of the US Army Science Board. He retired from the US Army after 30-years in uniform. John has appeared on radio, podcast, and television shows to discuss military topics and is the author of 16 books and hundreds of magazine articles on military and leadership subjects.

XR is the conglomeration of three realities: Virtual Reality, Augmented Reality and Mixed Reality. Integrating XR into Live (soldiers training on real systems), Virtual (soldiers operating simulated systems), and Constructive (soldiers placed in a manual or computer driven simulation to learn specific tactics, techniques or procedures) training can offer a viable, cost-effective means to train forces for offensive and defensive UAS warfare.

Virtual Reality (VR) Systems

VR places the user in a computer-generated, virtual world. VR has rapidly evolved in commercial gaming and education over the past two decades, and VR systems are used to train warfighters, units and staffs. One example is Virtual Battlespace 3 (VBS3) developed by Bohemia Interactive Simulations. VBS3 is a comprehensive, desktop training package used by NATO forces that is based on commercial video

game technology. The latest version is VBS4, which can connect to a VR headset, such as the Oculus QUEST, to create an immersive training environment. Oculus QUEST, developed by Facebook, is a stand-alone device that runs on the Android operating system and retails for about US$400. The US Army and many NATO countries use Oculus headsets for immersive training. By adapting the existing VBS4 software development kit (SDK), trainers can create immersive scenarios similar to what occurred in the Nagorno-Karabakh War to raise tactical awareness of the emergent UAS threat, by adaptive, repetitive training in both offensive and CUAS scenarios.

Augmented Reality (AR)

AR also provides an available and inexpensive method of training for UAS warfare. AR overlays digital information onto the actual world and allows users to place virtual objects in the real world. This enables nearly any smart device with a camera and the proper software to function as an AR training tool. An example of AR is the "Call for Fire" app produced by Simulation Training Group and offered on the Apple App Store for US$1.99. It trains the user to call for artillery fire. Creating a similar AR app to provide for the placement of digital UAS targets onto actual, geospecific terrain, would permit a warfighter to engage enemy UAS with CUAS weapons. These digital targets could move at realistic speeds and

Photo: US Army photo

US Army soldiers of the 82d Airborne Division train with the IVAS headsets in March 2021.

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represent individual UAS systems or swarms. This entire exercise, conducted at the cost of a smartphone or tablet, software and battery power, would enable warfighters to train repetitively to gain mastery of critical cognitive tasks, thus transforming Commercial Off-The-Shelf (COTS) hardware, with specially designed software, into powerful, low-cost AR UAS training devices.

Mixed Reality (MR)

MR combines VR and AR into an environment that enables the user to interact with both the virtual and physical world in real time. The US Army is rapidly fielding an MR capability called the Integrated Visual Augmentation System (IVAS). The US Army Chief of Staff, Gen. James C. McConville, described IVAS as "cutting edge technology that will transform the way we train Soldiers, and the way Soldiers operate in combat." IVAS uses MR to provide soldiers with enhanced visual and command and control (C2) awareness. Developed by Microsoft using their Hololens2 technology, IVAS is both a tactical goggle and a training device. "HoloLens is essentially a Windows 10 computer that you wear on your face," said Mark Valentine, director of the Army team at Microsoft in November 2019, "but the display methodology is not a screen. It is now a mixed-reality portal to the real world." Using MR, digital holograms, representing enemy UAVs, could appear in the sky during live training. With the proper software, IVAS could engage warfighters in realistic UAS and CUAS battle scenarios.

Immersive Technologies

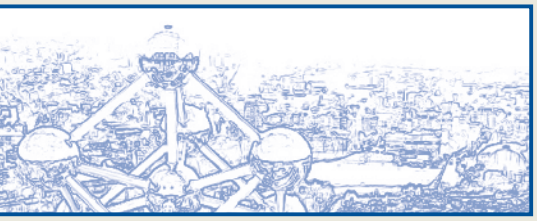
VR - Virtual Reality places the user into a computer-simulated world.
AR - Augmented Reality overlays information onto the actual world.
MR - Mixed Reality mixes VR and AR into reality to interact with physical and digital objects in real time.
XR - Extended Reality converges the VR, AR, and MR into one term.

Photo: Simulation Training Group

The illustration above is a "Call for Fire" trainer for smart phones and tablets that can be purchased for US$1.99 on the Apple App Store. With minor upgrades, apps like this could turn every smartphone or tablet into an augmented reality CUAS trainer.

Extended Reality (XR)

The key to training in XR is the development of military training software to run on COTS devices. VBS3 software is already available, and with targeted software modifications, could rapidly fill s portion of the UAS and CUAS training gap using VR. The next priority must be to develop immersive UAS and CUAS operations software for AR and MR devices. The US Army recognised the need for agile software development and will establish the first-of-its kind Army Software Factory in Austin, Texas, at the US Army's Futures Command, in the summer of 2021. In addition, the US Army recently awarded a contract to Octo, an Artificial Intelligence (AI) and Internet Technologies (IT) solutions company, and QinetiQ, British multinational defence technology company headquartered in Farnborough, Hampshire, to provide machine and deep learning (ML and DL) support for the IVAS. These two new efforts will provide a robust software development base to help address the shortfalls in UAS and CUAS training. Recent history proves that UAS, used in the right conditions, are deadly and can be decisive. Leaders, both friendly and threat, who recognise this are actively pursuing ways to use UAS and to counter UAS in the next conflict. Most importantly, the most focused leaders are also looking for ways to train their forces to win in a battlespace saturated with unmanned systems. "The average Soldier, Airman, or Marine lacks adequate counter-UAS training. It is not fully embedded in the programme of instruction from basic training onward," said Lt. Col. David Morgan, with the Joint Counter-Small Unmanned Aircraft Systems Office's Requirements and Capabilities Division in October 2020. This statement is also accurate for all NATO forces and represents a glaring training deficit. As a result, training for offensive and defensive UAS and CUAS operations in XR has the potential to be the most immediate and cost-effective method to provide immersive training to combat the looming UAS threat. ■



The Brussels Backdrop

Photo: author

Renewed Tensions in the World

Joris Verbeurgt

Many believed that the world would become a safer place after Donald Trump left the White House. Joe Biden's announcement on 14 April that the US would withdraw its last troops from Afghanistan before 11 September 2021 (the twentieth anniversary of the 9/11 attacks) confirmed that perception.

However, after a hundred days in office, old conflicts seem to have arisen anew. Tensions between Russia and Ukraine are increasing while Moscow is building up troops along the Ukrainian border. Furthermore, China is suppressing the opposition in Hong Kong, has threatened Taiwan with military action and is increasing its military activity in the Taiwan Strait. North Korea has launched a new tactical projectile, violating UN Resolution 1718 and provoking South Korea, Japan and the US. The Iranian nuclear programme is giving cause for concern in Israel and the US and has triggered a cyber-attack on the Iranian nuclear facility at Natanz.

Russia

In April, Ukrainian and NATO intelligence services reported a steady Russian military build-up in Crimea and along the Ukrainian border. Reliable figures concerning the build-up are difficult to obtain, but it is certain that tens of thousands of Russian soldiers - including an airborne assault brigade of 4,000 – are deployed on or near the borders with Ukraine. They are ready to intervene in eastern Ukraine where Moscow can also count on thousands of fighters organised in paramilitary militia. In response to the Russian military build-up, the US has sent navy ships towards the Black Sea. The hostile rhetoric is intensifying and Moscow has advised the US and NATO not to interfere for their own good. Biden called Putin for a meeting to take place in the coming months. This might postpone a possible Russian attack on Ukraine, although you never know with Putin. The annexation of the Crimea in 2014 also came unexpectedly and the West had no other response than economic sanctions that hurt the western countries as much as they hurt Russia. Anyhow, by requesting a meeting with Putin, Biden blinked first, which puts Moscow in a comfortable seat to start negotiations, leaving the option of an invasion of Ukraine open.

China

China is gradually enforcing its non-democratic legislation on Hong Kong – although international treaties guarantee the 'special status' of Hong Kong within China – and is sending the opposition to prison. The only protests from abroad are coming from the EU and the US, but for China, there are no real repercussions. These weak protests convinced Beijing that it has nothing to fear from the EU or the US. The weak response of the North Atlantic nations also triggered Beijing to tighten the screws on Taiwan, a country that the Chinese still considers as a rebellious province. In April, China began a large naval exercise off the coast of Taiwan, which included an aircraft carrier. China has also sent at least 25 warplanes recently into Taiwan's air defence zone. At the same time, Chinese naval vessels are heading for the Philippines, which caused the US State Department to warn China that any 'aggressive moves' towards the Philippines or 'actions' against Taiwan, would be a mistake. In reaction to that warning, Beijing warned the US 'not to play with fire'. North Korea is also provoking the US with the launch of a new type of a short-range 'tactical projectile', which triggered a statement from Biden that North Korea was number one on the American priority list.

Iran

In 2018, Trump withdrew the US from the deal with Iran concluded under the Obama administration. Since then, Iran has restarted its nuclear programme. Although Biden confirmed that he wanted to renew the Iran nuclear deal – the lifting of the economic sanctions against Iran if the country renounces its plan to become a nuclear power - Iran has continued with its nuclear programme, much to the dislike of arch enemy, Israel. In mid-April, just as Teheran announced the launch of its latest centrifuges at the Natanz, a power blackout damaged some of the facility's precious machines. It is believed that Israel and the US sabotaged the facility through a cyber-attack. Iran considers the attack to be a 'terrorist attack' and swore vengeance. Just like in 2019, the Gulf of Oman could become a primary target for Iran-sponsored attacks, threatening the supply of gas and oil to Europe and the rest of the world.

Conclusion

Although Biden was elected on a programme based on the peaceful resolution of problems, tensions are increasing in at least four regions in the world. Are Russia, China, North Korea and Iran just testing President Biden and trying to find his weak spot? Or are the EU, the US and NATO capable of handling these crises, especially when they escalate all at the same time? Is the West perceived as weak at this moment, since corona is wrecking western economies and societies? Is the election of Biden offering the West's adversaries a window of opportunity to take the initiative? Whatever the future may bring, it is certain that Biden will need a lot of statesmanship and persuasive power to prevent the development of crises and even the outbreak of war with adversaries who have proven to be capable of and willing to use force to obtain their goals.

Battery Management – Systems and Technologies

Tim Guest

The electronic monitoring and control of battery performance is now an essential aspect of battery usage, particularly as Li-ion technology has proliferated in both military and civilian applications.

There are few operational scenarios today in which a battery, of one sort or another, does not have some role – often critical – to play. From batteries powering individual soldier system sensors, to those for manpack or vehicle-borne tactical radios, or vehicle batteries themselves, applications for batteries are widespread and increasingly demanding. And with the advent and rapid evolution – in part driven by the commercial mobile communications sector – of Li-ion and other advanced battery technologies, the performance and capabilities of new batteries are improving all the time. But no matter what the technology, whether based on Li-ion or longer-established lead-acid, the last thing any soldier wants to discover at the point of "Contact!" is that any of the batteries powering his/her equipment is low on charge, or worse, completely dead.

This is where technology and systems to monitor, manage and display a battery's charge levels play a vital role. This article takes a look at battery management system (BMS – some use BPMS for battery power management system) developments and their technology.

Photo: GDLS

The Lithium Battery Company (LBC), which supplies batteries for GDLS` MUTT unmanned ground vehicle (UGV) for the US Army's Small Multi-Purpose Equipment Transport (SMET) requirement, invented an exclusive BMS that is programmable to meet the high endurance battlefield requirements for the MUTT UGV. The proprietary BMS technology can be monitored in real-time through an on-board computer, creating the ability to adjust performance parameters from anywhere in the world.

Setting the Scene

The term BMS covers a range of systems involving integral electronic monitoring circuits, or embedded or external software systems that enable the electronic monitoring and management of a battery's performance. While military markets took up the use of Li-ion batteries when they first emerged due to their greater energy density, advances in the mobile device industry, (an industry which adopted Li-ion from the outset and has driven many of its advances), also demanded efficient and simple battery charging and management technologies to keep mobile device users continually informed as to the charge state of their batteries. Most ESD readers will have their own smartphone and charger; you will watch the charge bars in one or other corners of your screen through the day as they tell you how much charge you have left, indicating when you need to re-charge. And many will have annoying, frustrating, or serious anecdotes about situations when they failed to notice charge levels were low, when you could not re-charge, leaving the battery to run out before you had a chance to phone home to say you would be late for dinner, or could not pick up the kids from school. Maybe you could not phone the police in a roadside emergency. Well, none of those uncomfortable scenarios compare with a tactical radio operator tasked with calling in artillery fire support for a final protective fire mission and not being able to do so. That`s uncomfortable.

Author

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BMS Overview

Battery monitoring systems for capacity and state of health have existed since digital systems have used batteries, though true BMSs really became essential to the mainstream market with the introduction of rechargeable Li-ion batteries in the 1990s. According to Mike Hendey, Senior Systems Engineer at Lincad Battery Company, talking to ESD, the vital reduction in battery weight for a given volume, facilitated by the increased energy density of Li-ion, came at the cost of cells that require greatly increased electronic

Marine Systems

The booster for AIP submarines: Lithium-ion batteries (LIBs) from Kiel:

Marine Systems has forged ahead to provide partner navies with the advantages and benefits of LIB technology – an energy storage system in its own class.

Thanks to high power characteristics, LIBs are a symbiotic supplement to our Fuel Cell AIP system, now in the fourth generation. The combined effect of Fuel Cells and LIBs leads to an improvement of vital operational capabilities and tactical performance parameters. Underwater endurances increase and indiscretion rates sink, especially under high load conditions.

The new LIBs for submarines, developed in co-operation with our long-time partner SAFT, are absolutely safe and maintenance free. First modules will be ready for integration in the near future – and set tomorrow's standards in underwater technology.

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management. To function safely and to maximise useful life, Li-ion cells cannot be allowed to fully discharge, they must not be operated outside of certain temperature or current limits, and they must not be overcharged. Cell strings within a battery pack must also be kept within a certain voltage limit from one another to optimise battery performance. All this requires an electronic BMS, a term that covers a wide range of potential safety and management options. At its heart, a BMS will monitor battery voltage, battery current and battery temperature as well as the individual internal cell voltages; it will monitor operational parameters assigned to these elements and disable the battery (usually temporarily) if any of the defined set conditions are exceeded. This protects both the battery as well as the users; a Li-ion battery pushed beyond safe working limits may become unstable. A BMS can also provide capacity gauging and state of charge or warning alarm to a user to inform how a battery is handled.

For military applications, BMS technology has benefitted greatly from the advances in mobile device technology, where efficient battery management is a key consideration. Specialist companies have generated fully integrated silicon-based devices dedicated to battery management, which can reduce an entire BMS to a core management chip with a handful of peripheral components. These can be found in many battery-powered, portable military devices, considering that many ruggedised military tablets, laptops and radios are based on commercially equivalent devices.

Complex or Simple to Fit the Role

As far as latest BMS evolution is concerned, the key development in recent years, according to Lincad's Hendey, has been the improvement in quality of the integrated management systems mentioned above, combined with the further miniaturisation of electronic components and a vast improvement in their energy efficiency, driven in large part by the huge investment in the mobile phone market. This has led to the emergence of smaller, more efficient components and, in turn, to smaller, more efficient BMSs. At the same time, software systems have also improved over recent years, allowing increased complexity and functionality within the BMS. And with the changing operational demands of the modern battlefield, BMS requirements have largely been split into two parallel streams, namely increased simplicity for basic mobile systems and greatly improved

The Lincad BPMS

Lincad's first Li-ion BPMS was developed for the UK MoD in 1999 for the LIPS 1 battery. At the time, this technology offered a three-fold increase in energy density for the MoD's portable electronic countermeasures (ECM) equipment. The development of a BPMS from scratch was necessary due to the extreme operating environment the battery equipment was intended for. Military ECM systems require a battery and BPMS rugged enough to operate in challenging physical and electromagnetic environments. The BPMS developed for the LIPS 1 battery has ultimately evolved though several iterations and been used in thousands of batteries for the UK MoD and worldwide defence markets. The current iteration, as used in the LIPS 10 battery, has now been superseded by a newer generation BPMS. The very latest BPMS Mk2 still performs all the monitoring and safety functions of its predecessors, but with greatly improved peripheral functionality and improved efficiency. It still monitors battery current flow to cut off the unit in the event an over current level is detected on load or charge. Battery and cell string voltages are monitored to ensure the battery is not overcharged or discharged to the point where cell damage may occur. Cell string voltages are maintained to within fine tolerances of one another through active balancing. Battery temperatures are monitored to ensure that if the unit becomes too hot, the output is cut off and if the unit is too cold, charging is not permitted so as not to damage the cells. All the active parameters are constantly monitored and if the output is cut off at any point, it is automatically re-established if a fault is found to have cleared.

Photo: Lincad Battery Company

The BPMS Mk2. Product shot

Lincad's latest BPMS Mk2, being marketed in the Asia Pacific through Leonardo, includes flash memory for several years of internal data logging. In addition to the usual IrDA communications interface, RS485 or SMBus communications are also available. Improved electronic components provide a greatly improved battery storage time, both in a charged and discharged state, to ensure cell damage does not occur if the batteries are not regularly maintained. The updated software has also been optimised for in-service update, meaning the functionality of the battery may be altered at any time without having to return the units to base. Reprogramming, monitoring and general battery interface activities are now also possible via an app running on a tablet or smart phone.

Photo: Lincad Battery Company

Lincad's BPMS Mk2 is a 120Ah lithium-ion battery system that contains the battery charge management and power routing electronics required for self-contained UPS functionality. It has been designed to support a 24V DC power supply and to upgrade and replace Lincad's original BPMS. Pictured here, BPMS Mk2 in use on a 105mm Light Gun.

New Submarine Li-ion Application and the Need for a Reliable BMS

Photo: tkMS

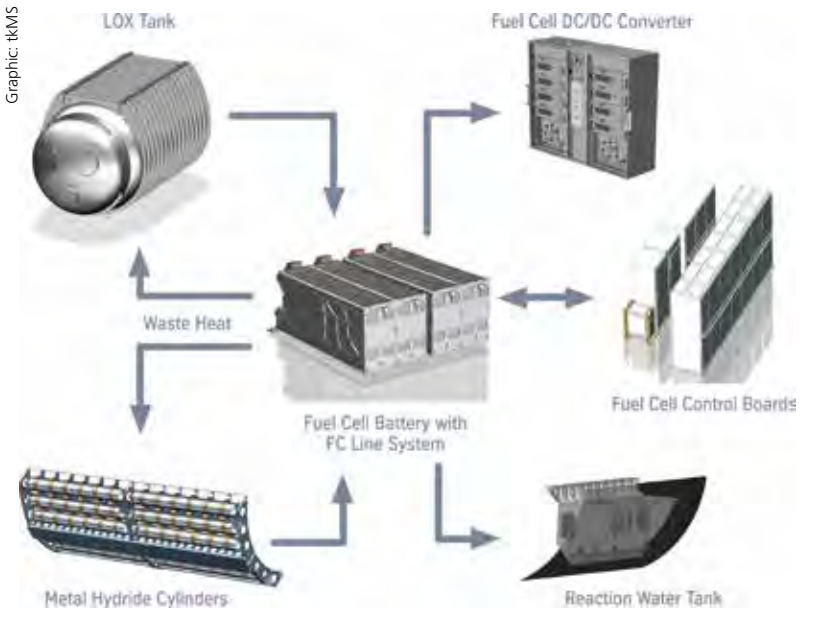
A Type 212A submarine on land. The new Li-ion battery system has been designed for integration into new submarine projects for HDW Class 212.

Thyssen Krupp Marine Systems (tkMS) launched a new Li-ion battery system back in 2018, initially for submarines. The development was a cooperative effort with advanced battery system maker, Saft. Dr Rolf Wirtz, CEO of tkMS said at the time that the new battery technology has enormous tactical advantages as the sector enters "a new era of submarine construction"; maintenance of the new system, for example, compared to known lead-acid battery systems, is negligible with a much longer lifetime. In addition to a system design – including safe cell chemistry - tailored to safety and to the special requirements of operating in the maritime sector, a series of early tests successfully demonstrated the safety at battery cell and system level. The new Li-ion battery has been designed for integration into new submarine projects for HDW Class 212, as well as re-fit solutions into existing weapon platforms. Integration into HDW Class 214 is also planned and due to the modular design of the battery system, it can, in principal, be adapted to fit into any naval application. With agreement now reached, as of March this year, between tkMS and the procurement authorities of Germany and Norway, (and in partnership with Kongsberg Defence & Aerospace), on the general conditions for the purchase of six Type 212 CD (Common Design) submarines, the new battery system will be one of several advanced technologies to be integrated and expand the U212 family in Europe. Construction of the first submarine could begin in 2023 if the contract is signed this summer. Delivery of the first submarine for the Norwegian Navy is expected from 2029, while delivery of the two boats for the German Navy is scheduled for 2031 and 2034.

Such a critical Li-ion battery application, however, cries out for battery management and ESD spoke with Peter Hauschildt, Head of Technology & Innovation at tkMS to find out more. He emphasised that for Li-ion batteries (LIB) a BMS is essential – especially for submarines. "In submarine applications, safety is more crucial than in almost all other applications, since a submarine is a closed, inhabited atmosphere, which the crew cannot instantly leave in case of danger. LIB pose a significant fire hazard; in the event of overcharge, short circuit, deep discharge, or mechanical damage LIB can cause a fire. For many of the used chemistries of LIB, the resulting fire cannot easily be extinguished, because the battery cells don't just contain combustibles, they also release oxygen when overheated. That is why tkMS chose an iron phosphate chemistry, which is much safer than other chemistries, but has a slightly lower energy density; iron phosphate cells do not produce oxygen when overheated and are, therefore, much safer. Nevertheless, the LIB has a significantly higher energy density, especially at high discharge rates." Hauschildt added that overcharge, short circuit, deep discharge must, nevertheless, be safely avoided by the BMS and because these functions are safety critical, the BMS must be extremely reliable. He said that beside safety features, the BMS takes care of balancing, which means it takes care of, and ensures, all cells have the same voltage/state of charge; it monitors the state of charge of the complete battery and monitors the state of health of each single cell. Charging is done by the diesel generators and is, in general, controlled by them. The BMS takes care that charging stays in nominal ranges and that each partial battery is equally charged.

Beyond Li-ion expertise, tkMS has also pioneered fuel cells (FCs), which, in relation to BMS, do have an automation system for starting, stopping and control functions. tkMS' FC system used on board ships, is connected to a ship's main network via a DC/DC converter that limits the maximum load on the FC to the rated output. As long as the demand is lower than the rated output, the FC produces as much power as needed.

Graphic: tkMS



tkMS' FC system has an automation system for starting, stopping and control functions.

Photo: Bren-Tronics

Battery systems for military applications from Bren-Tronics, including the 2.8Ah high-capacity, low-temperature, rechargeable BB-2557/U Li-ion battery (far right foreground), incorporate indicators showing users how much power is left in these batteries. The BB-2557/U is used for night vision systems, unmanned robotics and remotely monitored battlefield sensor systems such as ground surveillance radar.

functionality and flexibility for higher cost systems; a small handheld radio, for example, may be driven by the need for a simple, rugged, reliable battery at a low cost. In such a case, a basic 'no frills' BMS using minimal, optimally efficient components would be preferred. In a more complicated system, on the other hand, like a vehicle powertrain battery, the BMS would, by necessity, be vastly more complicated, though in cases like this functionality and flexibility are of great importance. At the same time, in the modern environment where cost factors are critical, every component must offer the best possible value for money and the ability to adapt a battery to differing requirements over time is preferred over a unit that would need to be replaced if requirements change. This can be achieved through more intelligent, 'future-proof', electronic design, as well as optimising software systems for in-service alteration. Electronic hardware and software improvements are also satisfying the modern requirement for data feedback. Military and civilian users are now accustomed to receiving and processing vast amounts of data to optimise performance in operational situations. Data from battery systems can be of use to connected systems and users, in order to ensure they are being used in the best possible way.

And whether a BMS is designed for use with a vehicle battery, or soldier-worn or hand-held radio battery, for instance, the fundamentals need not be vastly different. It is simply a question of scale and complexity, as applied to the voltage, current and temperature monitoring circuit, and the information feedback methodology. A vehicle battery, for example, will naturally need components that can deal with larger currents and generally higher voltages, but it will still need to monitor and manage the same basic elements. A larger vehicle BMS is, however, likely to require more in the way of complex peripheral functionality than a smaller system might. On the other hand, the user of a handheld radio may only be interested in the state of charge of the battery and very little else compared with a vehicle battery, which will need more complex communications feedback to satisfy the more complicated operating environment. Potential requirements are very broad, but one example may be the need for ethernet, or other communications, to link the battery to the vehicle's on-board computers, something which would be unnecessary for a smaller battery.

BMS, Chemistry and the Future

When it comes to different battery chemistries, e.g. Li-ion versus alkaline, the less energy-dense technologies like nickel cadmium (NiCd) and nickel metal hydride (NiMH) are less dependent on a BMS and these, along with primary batteries, may just be used with passive protection components or simplified monitoring circuits. Where a BMS is applied to different technologies, the fundamentals from one system to the next will generally be consistent. The relevant operational safety parameters of any battery will be the voltage, current and temperature of the unit and the monitoring and protection

Photo: Saft

Based on the 28V Lithium Battery Box (LBB) developed for the US Army's TOW Missile, the high-power LBB is a 28 V, 100 amp/hour battery made up of high-energy Li-ion cells.

principles will apply across different technologies. The complexity and precision of the monitoring and control will be dictated by the specific chemistry of a given battery.

As to the future, BMS technology continues to evolve and smaller, more efficient components will, in turn, lead to smaller, more efficient BMSs. Lincad's Hendey adds that further integration with the control systems of powered equipment will lead to even greater flexibility, and standardisation across battery systems is also likely, in turn leading to cost reductions for newly developed products. ■

Acknowledgement: Thanks go to the Lincad Battery Company for their support and input to this article.

A Modular Approach to Power

Stefan Stenzel, Managing Director of mechatronics manufacturer VINCORION, on modular power systems, engineer-to-engineer dialogue, and why customer support and Maintenance, Repair and Overhaul (MRO) management already play a decisive role during the project planning stage.

Why does power need to be managed?
Stenzel: The amount of equipment in military platforms that consumes power has been increasing for decades – whether in tracked vehicles or fighter jets, in air defence, or in field camps. In fact, technological developments such as active protection systems or the increasing connectivity of combat units are actually accelerating this trend. At the same time, power systems used in global deployment scenarios must meet increasing demands when it comes to mobility, ruggedness, and serviceability. This means that we are dealing with extremely complex systems that must be guaranteed to deliver a high level of flexibility and availability.

When you talk about power systems, what do you mean exactly?
Stenzel: That depends on the deployment scenario. Depending on the requirements, we combine components that we use to generate, store, convert, and manage power. The challenge is adapting these to specific specifications, i.e. in terms of power output, storage capacity, installation space, or weight, for example. We have a kind of modular assembly kit for this purpose, which we use to create the most suitable solution for the target system in each case – from the smallest quantities to the larger series. In addition, a great deal of software and sensor technology is now available that makes it possible to make precise statements about the condition of the system and to operate it even as a non-expert.

The GT Drive Modular gun turret and weapon stabilisation system

To what extent does software and sensor technology make power systems better?
Stenzel: When it comes to a power storage unit's state of charge or service life, for example, conventional systems usually do not allow very precise statements to be made. If we are only talking about a cell phone battery or car battery, you can usually live with that. In our areas of operation, however, a system failure can have extremely serious consequences. This is why we are working on more intelligent analysis methods and algorithms that allow the remaining charge of a storage unit or the optimum time for maintenance to be estimated as accurately possible, for example with the Kiel University of Applied Sciences, which is using artificial intelligence and machine learning methods for this purpose. In doing so, we are laying the foundation for predictive maintenance. That is part of what we refer to as Customer Support 4.0.

Can you explain that in more detail?
Stenzel: Our goal is to develop low-maintenance solutions that will continue to provide reliable service for decades to come. But it is also clear that in the case of products with extremely long life cycles, there are limits to this. Technologies evolve rapidly, requirements and specifications change. That is why it is essential for us to take a holistic approach to MRO and consider all aspects of life cycle management right from the very beginning. Our customers have every right to expect us to adapt our components to the conditions, and do so in the shortest possible amount of time; with the alternative being the customers performing this work themselves under our guidance. Data analytics, sensor technology, intelligently connected components, stockpiling – all of these play a critical role right from the initial project planning stage.

How is this reflected in your products?
Stenzel: It is evident in the fact that we systematically apply our modular approach right down to the product level. Portable power management modules, or P2M2 for short, are one product which we have recently developed that can be used to harness all available power sources and can be powered via storage modules independently of other power sources. This means that military units can select the appropriate modular power supply for each mission without having to deal with complex logistics. Together with SFC Energy AG, we are developing a fuel cell module that will offer an even greater degree of self-sufficiency. Similarly, our GTdrive Modular stabilization system is designed as a modular system that can be scaled to meet the needs of any platform. This means that instead of upgrading an entire system, we can make very targeted adjustments to individual components and thus both reduce development efforts and shorten our time-to-market.

Photos: VINCORION

Stefan Stenzel, Managing Director of VINCORION

Where do the ideas for these developments come from?
Stenzel: Our dialogue with our customers is the main engine driving our innovation activities. We are not in the business of manufacturing off-the-shelf products, but instead develop tailored solutions for very specific challenges. The engineer-to-engineer dialogue that we maintain with our customers to this end is at the very core of our work. Our advantage is that we have mastered the engineering triathlon – we are experts when it comes to combining electronic components, mechanic components, and innovative materials. And this is how we create products that have never existed before, and what gives us our unique position.

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Rising Demand for Medium Tanks

Christopher F Foss

While many countries continue to deploy main battle tanks (MBTs), there is now an emerging market in some parts of the world for the so-called medium tank (MT).

The main role for MTs would normally be to provide direct fire support to dismounted infantry using High Explosive (HE), High Explosive Squash Head (HESH) or in the longer term, Air Burst HE (AB HE) types of ammunition. Some of these recently developed MTs are essentially an infantry fighting vehicle (IFV) or armoured personnel carrier (APC) platform fitted with a manned turret typically armed with a 105 mm rifled gun, or in some cases, a 120 mm smooth bore gun.

US Mobile Protected Firepower

The US Army did deploy the M551 SHERIDAN which was officially called the SHERIDAN Armoured Reconnaissance Airborne Assault Vehicle, Full Tracked, 152 mm, but the vehicle was phased out of service.

Using internal research and development funding, the now BAE Systems (then FMC Corporation) developed the Close Combat Vehicle – Light (CCV-L) featuring a 105 mm M35 rifled gun fed by an automatic loader enabling the crew to be reduced to commander, gunner and driver. Its low weight enabled it to be carried in a Lockheed Martin C-130 transport aircraft. The vehicle never entered production but further development resulted in the M8 Armoured Gun System (AGS) which, although type classified by the US Army, also never entered production. It was also armed with a 105 mm gun fed by an automatic loader and had a modular armour package that could be tailored to meet the anticipated threat level with the Stage 3 featuring explosive reactive armour (ERA) packages for its hull and turret to provide a high level of protection against threat weapons fitted with a HEAT warhead.

General Dynamics Land Systems entry for the US Army Mobile Protected Firepower requirement fitted with a turret armed with a 105 mm rifled gun, 7.62 mm co-axial MG and roof mounted 12.7 mm MG

The US Army has a new requirement for a Mobile Protected Firepower (MPF) and following a competition, General Dynamics Land Systems (GDLS) and BAE Systems were each awarded contracts to build 12 prototypes which are undergoing extensive trials. The chosen prototype will be selected for Low Rate Initial Production (LRIP) phase under which 26 will be built with an anticipated total production run of 504 units for use with the Infantry Brigade Combat Teams (IBCT).

GDLS confirmed that their "MPF approach leverages a combination of recently developed and battle tested designs." It features a four-person crew and will be powered by a front-mounted diesel engine coupled to a fully automatic transmission with hydro-pneumatic suspension for higher cross-country mobility. The main armament is a 105 mm rifled gun, coupled to the ABRAMS M1A2 System Enhancement Package (SEP) v3 fire control system (FCS) and a Commander`s Independent Thermal Viewer (CITV), to provide a hunter/killer capability.

The BAE Systems prototype is a further development of the M8 AGS and is also being armed with a 105 mm gun fed by an automatic loader which will be laid onto the target using a computerised FCS. It has a crew of three and is fitted with a rear-mounted roll-out power pack consisting of engine, transmission and cooling system. Its composite track is quieter, has lower vibration than a conventional steel track and has less rolling resistance.

The Swedish CV90120-T

Using internal research and development, BAE Systems Hägglunds designed and built the CV90120-T tank consisting of a CV90 Mk 0 IFV hull fitted with a new three-person turret armed with a Swiss RUAG Defence 120 mm L50 smooth bore Compact Tank Gun (CTG).

When RUAG ceased marketing this 120 mm CTG, it was changed for a Rheinmetall Rh 120 LLR L/47 120 mm smooth bore gun. According to Dan Lindell, of Direct Combat Vehicles, "The LLR L/47 was integrated, mechanically and electronically into the turret, but never fired. The proof of concept, firing wise, has been with the 120 mm CTG." Marketing the CV90120-T is still ongoing but production would be based on the latest CV90 Mk 4 hull launched in 2018 with the option of the new D series turret which can be fitted with a variety of weapons, ranging from a 30 mm cannon up to a 120 mm smooth bore gun and a 7.62 mm co-axial MG. BAE Systems Hägglunds are quoting the CV90 Mk 4 with a gross vehicle weight (GVW) of up to 38 tonnes of which 19 tonnes is the payload.

The CV90 Mk 4 also has fourth generation NATO-standard electronic architecture,

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.

active damping suspension and a power pack consisting of a Scania diesel, developing 860 hp, with growth potential up to 1,000 hp, coupled to a Caterpillar X-300 fully automatic transmission. In a statement, BAE Systems said, "We also have an active dialogue with a number of countries interested in the 120 mm capability and we have performed demonstrations during 2019."

Photo: BAE

BAE Systems' proposal for the US Army MPF requirement is based on their M8 Armoured Gun System armed with a 105 mm gun fed by an automatic loader.

The TIGER / HARIMAU Medium Tank

The TIGER, or HARIMAU in Turkish, is been developed by FNSS Savunma Sistermleri (Turkey), PT Pindad (Indonesia) and John Cockerill Defense (previously CMI Defence) (Belgium) to meet the requirements of the Indonesian Army. It is also referred to as the KAPLAN Modern Medium Weight Tank (MMWT) by FNSS.

The TIGER consists of a new platform that is based on the FNSS Armoured Combat Vehicle - 30 (ACV-30) fitted with the Belgian John Cockerill Defense C3105 turret armed with a high pressure 105 mm rifled gun fed by a bustle-mounted automatic loader enabling the crew to be reduced to commander, gunner and driver. Two examples of the TIGER MT were completed, one in Turkey (P1) and one in the Philippines (P2), plus a hull for ballistic trials.

In May 2019, FNSS and Pindad signed an agreement to support serial production of the TIGER with an initial contract signed for a first production batch of 18 vehicles manufactured in Indonesia with sub-systems such as the power pack and suspension supplied by FNSS and the turret from John Cockerill Defense.

FNSS are quoting a combat weight of 30 tonnes with the Caterpillar 700 hp diesel coupled to an Allison automatic transmission giving a maximum road speed of up to 70 km/h. A computerised FCS is fitted with commander and gunner with stabilised day/thermal sights incorporating a laser rangefinder for increased first round hit. Other features include an auxiliary power unit (APU) allowing for the main engine to be shut down to save power, land navigation system, battle management system (BMS), laser warning system and 360 degrees situational awareness cameras.

The ASCOD 120 mm

This is officially called the ASCOD Medium Main Battle Tank (MMBT) and was shown for the first time in mid-2018, representing a joint development for the export market between General Dynamics European Land Systems Santa Barbara Sistemas (GDELS-SBS) of Spain and Leonardo Defence Systems of Italy. ASCOD refers to Austrian Spanish Co-operative Development (ASCOD) and is deployed in Spain as the PIZARRO IFV and in Austria as the ULAN IFV. Further development of the ASCOD has resulted in the British Army's new fleet of tracked vehicles with AJAX being the key reconnaissance platform.

Photo: BAE Systems

BAE Systems Hägglunds CV 90120-T armed with a Rheinmetall 120 mm smoothbore gun and fitted with adaptive signature reduction package for trial purposes.

The ASCOD MMBT uses a common base platform (CBP) with GDELS offering a different upper hull to meet specific user requirements. GDELS are quoting a GVW of 42 tonnes with the hull incorporating stealth technology, qualified mine protection package, modular add-on armour package and full digital electronic architecture.

The ASCOD MMBT is fitted with the Leonardo Defence Systems HITFACT 120 turret armed with a manually loaded 120 mm smooth bore gun fitted with a muzzle brake, thermal sleeve and fume extractor, 7.62 mm co-axial MG, one roof mounted 7.62 mm MG and one RWS armed with a .50 M2 HB MG.

A computerised FCS is fitted plus day/thermal sights for commander and gunners incorporating a laser rangefinder. The commander's sight is of the panoramic type.

The first example of the ASCOD MMBT was fitted with one of the prototype HITFACT 120 turrets installed on the CENTAURO 2 Mobile Gun System (MGS) developed for the Italian Army as a follow-on to the currently deployed 105 mm CENTAURO.

Since the ASCOD MMBT was launched, a production order for CENTAURO 2 has been placed consisting of 10 production vehicles, plus the original prototype rebuilt to the latest production standard. This includes improvements to the HITFACT 120 turret which would be fitted to the ASCOD MMBT if this entered production.

The SABRAH

In January 2021, Elbit Systems announced that it had been awarded a US$172M contract to supply light tanks to an undisclosed country in Asia with deliveries to be carried out over a three-year period.

The customer is the Philippines with two platforms, one the GDELS ASCOD and

Photo: Christopher F Foss

TIGER (HARIMAU) MT has been developed to meet the operational requirements of Indonesia and is fitted with a John Cockerill Defense C3105 turret armed with a 105 mm high pressure rifled gun fed by an automatic loader.

Photo: Christopher F Foss

The ASCOD MMBT is based on an ASCOD platform fitted with the Leonardo Defense Systems HITFACT 120 turret armed with a 120 mm manually loaded smoothbore gun.

the other the PANDUR II (8x8) which was originally designed and manufactured by GDELS in Austria but is now manufactured by Excalibur in the Czech Republic.
Both of these vehicles feature a turret armed with a 105 mm rifled gun coupled to a computerised FCS supplied by Elbit which is also fitting the TORCH-X battle management system and the E-LYNX software defined radio system.

The Otokar TULPAR MT

The TULPAR has been developed by Otokar as a private venture for the export market and complements their expanding range of 4x4, 6x6 and 8x8 wheeled AFVs. It essentially consists of the hull of their TULPAR IFV fitted with the John Cockerill Defense C3015 turret previously mentioned and which is currently in production for the GDLS – Canada LAV (8x8) for the Kingdom of Saudi Arabia.
The TULPAR was originally powered by a German MTU 8V 199 16-litre turbocharged diesel engine developing 720 hp coupled to a Renk HSWL automatic transmission. The latest version is powered by a Swedish Scania DI 16 diesel developing 850 hp coupled to a Spanish SAPA Transmission 860C fully automatic power shift transmission. The TULPAR GVW weight depends on the weapon fit and the armour package but Otokar are quoting a maximum GVW of up to 42 tonnes.

The Rheinmetall LYNX

Rheinmetall Defence of Germany launched their private venture LYNX KF41 (Kettenfahrzeug – meaning tracked vehicle) IFV in June 2016 followed by a second example in 2018. Hungary has placed a contract order for 218 LYNX IFVs and it has been shortlisted by Australia for Land 400 Phase 3 for a new tracked FOV. The other contender is the REDBACK from South Korea.
While it is currently configured for the IFV roles with a weight of between 34 – 50 tonnes, the LYNX has an adaptable and reconfigurable design allowing it to be fitted with much heavier turrets, including armed with a 120 mm smooth bore gun.

The HUNTER Fire Support Variant

To meet the operational requirements of the Singapore Army, STK Engineering Land Systems, in conjunction with the Singapore Defence Science and Technology Agency, developed the Next Generation Armoured Fighting Vehicle (Next Gen AFV) which was subsequently called the HUNTER and is now in production for Singapore in the IFV configuration.
To meet the MPF programme of the US Army, Science Applications International Corporation (SAIC) and ST Engineering Land Systems offered a version of the NGAFV fitted with the John Cockerill Defense C3105 turret as previously mentioned. This proposal was not selected, but STK Land Engineering Land Systems is now marketing this combination as the HUNTER Fire Support Variant and the first version has been retained in Singapore. STK Engineering Land Systems are quoting a GVW of 32.5 tonnes which depends on the protection level required. It is powered by a MTU 8V-199 TE20 diesel coupled to the Kinetics Drive Solutions

Photo: STK Engineering Land Systems

HUNTER Fire Support Variant integrates the STK Engineering Land Systems HUNTER platform with the John Cockerill Defense C3015 two-person turret.

HMX3000 automatic transmission which gives a power-to-weight ratio of 21.8 hp/tonne, maximum road speed of up to 70 km/h and a range of up to 500 km. As the chassis and turret are in production, early deliveries could potentially be made to potential customers.

The K-21 105 mm/120 mm

Hanwha Land Systems of South Korea marketed their K-21 IFV platform fitted with a John Cockerill Defense turret armed with a 105 mm or 120 mm gun. Production of the K-21 IFV has been completed and the main emphasis is now on their latest REDBACK platform; fitted with the latest C3105, this was also a contender for the Philippines requirement subsequently won by Elbit Systems.

Other Contenders

The only similar vehicle to come out of Russia is the 2S25 SPRUT-D, which is referred to as a self-propelled anti-tank gun (SPATG). But with a GVW of 18 tonnes, it could potentially be classed as a MT. The SPRUT is armed with a 125 mm 2A75 smooth bore gun fed by an automatic loader holding 22 rounds of separate loading ammunition and in addition to firing conventional natures of ammunition, can also fire a LGP as fired by Russian MBTs. It also has a co-axial 7.62 mm MG and has adjustable hydro pneumatic suspension and is fully amphibious being propelled in the water by two water jets. Further development has resulted in the 2S25 SDM1 which has a similar layout but a new hull and turret with the latter being armed with the 125 mm 2A75M smooth bore gun fed by an automatic loader holding 22 rounds of separate loading ammunition, 7.62 mm co-axial MG and a roof mounted 7.62 mm RWS.

Photo: Elbit

First photo released of the SABRAH MT developed by Elbit Systems and based on the ASCOD platform with the Philippines as the launch customer.

China North Industries Corporation (NORINCO) are marketing the VT5 Lightweight MBT which has a crew of three and is armed with a 105 mm gun fed by a bustle mounted automatic loader which has enabled the crew to be reduced to three. Its GVW is quoted as being between 33 and 36 tonnes, depending on the modular armour package fitted.

The VT5 is in service with the Peoples Liberation Army (Army) as the Type 15 and has also been sold to Bangladesh. Components of the VT5 are also used as the basis for an IFV fitted with a remote controlled turret armed with a 30 mm cannon, 7.62 mm MG and an ATGW either side. ■

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Integrated Advantage: Networking C-UAV systems

Gerrard Cowan

Counter-Unmanned Aerial Vehicle (C-UAV) networking is an increasing focus for military operators, with a range of sensors and effectors integrated together to create a 'system of systems'. While such networking brings a number of challenges, it can provide users with a significant effects multiplier.

Photo: Chess Dynamics

A Chess Dynamics C-UAV system

Author

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He was previously a News Editor at The Wall Street Journal and Europe Editor at Jane's, and is the author of 'The Machinery' trilogy, published by HarperCollins.

Operator demand for a wide range of systems and effectors stems from a growing awareness that there is no 'silver bullet' to provide C-UAV, particularly when operating across large areas. This demands a number of sensors and effectors to adequately address the threat. Such networking could involve a number of different systems: integrating a radio frequency (RF) detector with a jammer or other effector, for instance. For example, in border protection, operators may have to protect an area running into hundreds of kilometres. They require multiple types of equipment to monitor this area, all of which must be networked together to provide a single, common operating picture. Different team members – potentially in different locations – must be able to log into the system securely, look at the screen and understand what is happening in a simple, intuitive manner, even if it involves equipment from different manufacturers. According to Oleg Vornik, DroneShield CEO, they "must be able to understand, in an easy way, what's going on, and get the knowledge to be able to act".

Companies must ensure that their own products – different sensors, for instance - can interact with one another at the appropriate level, while others will often acquire off-the-shelf sensors from third parties and integrate them with their own systems.

Additionally, recent years have seen a number of C-UAV specialists boost efforts to integrate their own C-UAV systems with those of other companies. For example, a recent deal between Thales and DroneShield will see the former's HORUS CAPTOR detection and tracking systems being integrated with the latter's neutralisation and detector systems. In particular, the project is integrating Thales' SQUIRE radar and its GECKO optronics system with DroneShield's DroneCannon effector.

Data Fusion

To integrate effectively, such systems must communicate and receive data in common formats, ensuring that information flows in a streamlined manner. This could be JavaScript Object Notation (JSON), for instance, an open standard data format. It is then fed into a common security area or command and control (C2) centre through a cable or via a router. This centralised area could be a physical location or a cloud-based instance.

Data fusion is at the heart of C2 for such a network, contributing to the reduction of false alarms and providing robustness in target tracking. This helps the operator to classify and identify targets. There are particular challenges here in C-UAV networking, due to the variety of sensors, including RF, optronics and more. There is therefore an emphasis on "heterogenous data fusion", according to Jean-Philippe Hardange, director of strategy for integrated airspace solutions at Thales, provider of the FORCESHIELD range of modular air defence solutions and a range of other radars and C-UAV systems.

The company integrates a variety of its own and other companies' assets in C-UAV networks depending on the particular mission segment, with the military domain generally demanding radars for detection and optronic sensors for identification and tracking. Thales usually proposes its GROUND MASTER 200 radar to detect small and tactical drones, complemented by a smaller radar to detect mini and micro-drones. The C2 Centre is underpinned by the company's CONTROLView system, which can integrate with any air defence weapon system.

Hensoldt's XPELLER C-UAV system also relies on a networking and data fusion approach, supported by its specialised CxEye software. This can integrate different Hensoldt sensors or those from other producers, such as radar, EO/IR, RF-direction find-

ers/receivers and effectors like jammers. Such software is designed to be adaptable; as with other manufacturers in the C-UAV sector, the company anticipates new technologies for detection and mitigation to emerge in the coming years, including extended artificial intelligence (AI) and new types of sensors and effectors, according to Michael Hirschner, Hensoldt`s head of security solutions.

Adaptability

C-UAV specialists aim to make their systems as adaptable and configurable as possible, based on the growing demand for networking and integration of various assets. For example, Raytheon Intelligence & Space (RI&S) uses an open-architecture system, which interfaces with C2 networks via a simple Ethernet connection, which is common in C2 structures. The system is also configurable, being able to adapt to a variety of platforms with software modifications.

There is no universal C2, so such systems are not always immediately 'plug and play'. Companies address this challenge through making the interface as open and flexible as possible, upgrading software when necessary to connect with the C2 systems of different services and countries. C-UAV systems are not yet prolific on all air defence networks, though this is something that is expected to change in the coming years, in the view of industry experts.

RI&S's High Energy Laser Weapon System (HELWS) combines a high-energy laser with a beam director that has electro-optical/infrared (EO/IR) sensing capabilities. When it is plugged into an existing C2 network – for example, an air defence network – the EO/IR sensor and laser effector are immediately integrated with any other sensors and effectors on the C2 platform. Outlining possible combinations, Evan Hunt, lead for high-energy lasers at RI&S, said the HELWS could be combined with the company's KuRFS or Ku720 radars and then interface with the US Army's THAAD C2 system. This type of network could also include assets like the Coyote UAS.

Such networking must also consider the way in which data is presented to the operator, ensuring it is communicated in a simple form on a single interface. This is the case even if a network relies on multiple nodes: the data from these nodes must be collected together and presented in a single form. Often, this will require network integrators to work closely with external manufacturers to understand the way in which their information is transmitted and what exactly it is designed to do. For example, an integrator may work with a radar manufacturer to learn how their product can communicate the velocity, altitude and bearing of a UAV. The integrator may also wish to know how often the information is updated, along with a range of other demands.

Photo: Hensoldt

Hensoldt's XPELLER C-UAV system, pictured here, also relies on a networking and data fusion approach, supported by its specialised CxEye software.

Design Knowledge

For a manufacturer like Chess Dynamics, which produces the AirGuard C-UAV system, it is also important to understand the design thinking behind each individual piece of equipment in the network, and how the manufacturer has tailored their system to be part of the network. As network integrators, 'we must assume that the suppliers of the other subsystems aren't going to change in order to accommodate us', noted Sales Director David Eldridge.

Such integration is vital, because it allows the C-UAV network to ingest data from a range of sources, which must be achieved rapidly. A UAV moves rapidly, so the operator must be confident of receiving the necessary data very quickly and in a clearly understandable format, even if it is coming from a range of sources. These sources have expanded in recent years, with Eldridge highlighting in particular a new focus on a 'cyber' approach to both detecting and sometimes mitigating drones. This relies on passively intercepting the communication between a UAV and its controller, then using that information to provide a detection/alert to the presence of the UAV. However, they rely on the UAV type already being in a library, with the potential for a time lag as new UAVs are introduced. Additionally, they will not detect a UAV flying on its own GPS or other navigation system, Eldridge noted.

Overcoming Challenges

There are a number of challenges to network integration, such as latency: the potential for delay in data transfers. However, this can be addressed if the latency is at a known value: operators can predict where the UAV might be if they know its velocity and direction of travel, as is provided by most radars. Additionally, there can be security challenges, particularly centred on cyber attacks. Operators like Chess Dynamics work to mitigate this danger by maintaining the C-UAV system as a 'standalone' entity, so that effectively it is not online. However, some clients request that the C-UAV system is integrated with broader networks, which necessitates an emphasis on enhanced cybersecurity.

The environment of regulations and standards in the C-UAV space is not yet set in stone, with data exchange standards and the general interoperability of systems still in flux in different ways. This can be addressed through open standards. In the military segment, Hardange suggested that tactical data link standards like Link 16 could be good candidates for such open standards.

Each situation is unique. DroneShield, for instance, operates in about 100 different countries, with interoperability standards varying across the customer base. In some instances, it could be as simple

Photo: Thales

Thales manufactures the FORCESHIELD range of modular air defence solutions, among other radars and systems.

Photo: Raytheon Intelligence & Space

When Raytheon's HELWS is plugged into an existing C2 network – for example, an air defence network – the EO/IR sensor and laser effector are immediately integrated with any other sensors and effectors on the C2 platform.

Photo: DroneShield

The DroneCannon MKII from DroneShield

as running a cable between sensors, but the quality of the connection can be disrupted if the cable is too long. Ensuring data and power connectivity can be a difficult challenge. Vornik noted that while a company can provide its equipment in different formats, the information and data still must be reliably ingested: for example, if it is being transmitted wirelessly, the integrator must ensure that the bandwidth is fit for purpose, particularly if there are large numbers of sensors involved.

One potential approach to mitigating this problem is 'processing at the edge'. This means that when the sensor receives the data, rather than sending it all back to a central point – which could overwhelm the network if there are a great deal of sensors involved – processing is brought right up to the point of the sensor itself, which only sends relevant information back to central command points when necessary. In this scenario, the sensor – such as a camera or an RF sensor – would essentially be asleep, sending back nothing most of the time, but when it senses a threat, it sends the relevant packet of data to the user. This reduces both the load on the system and the cognitive load on the operator.

Future Potential

The exploitation of data in massive quantities is only at the beginning, with the potential for vast increases in data being exploited by artificial intelligence (AI) algorithms to provide C-UAV operators with new capabilities. Hardange said his company is already seeing this to a certain degree, notably through simple replay functions, analysis of abnormal trajectories, and in cybersecurity.

When designing a system of systems like an integrated C-UAV network, it is vital that operators think through the architecture as a whole and how it is laid out. When designing a network, operators must consider the other systems in the environment, as well as the terrain and other facets. For example, a radar's performance might be affected by its positioning. This means sensors must be placed in such a way that they can hand over the target from one sensor to the next, with no gaps in between. All of this means there is a great deal that goes into networking a system together.

As Vornik notes, 'each individual component will have its own constraints and its own advantages – the design of individual sensors and designing a network are quite different exercises'. ■

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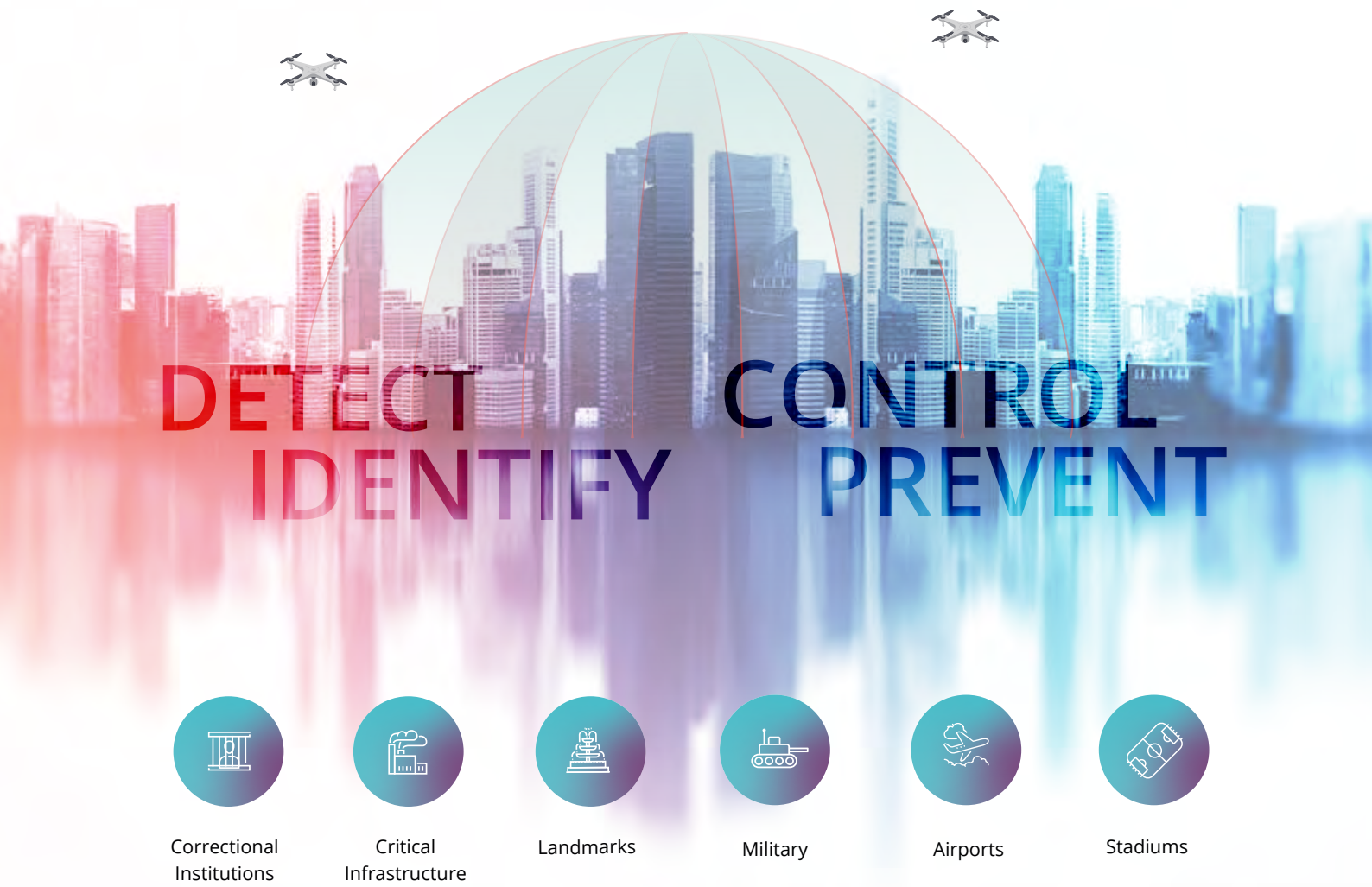

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A Drone Superpower

How Turkey's UAV Manufacturers are Transforming "Drone Diplomacy"

Korhan Özkilinc

Turkey has successfully closed the value chain for the production of UAVs by the domestic industry, thus ending its dependence on foreign suppliers which is important for Turkey given recent embroilments with the US over the F-35 aircraft and Russia over the S400 air defence system.

For the past decades, military UAVs have been very simple pieces of equipment but the technology has since evolved rapidly and profoundly. These systems are now in global use and represent a multi-billion dollar industry. One country that has begun to catch up in the last decade in particular is Turkey.

The first Turkish UAV was developed by Turkish Aerospace Industries (TAI) in 1989 under the name UAV-X1 at a time when there was no real strategy, except that Ankara just wanted to keep up with developments in western countries. At the outset, the pioneers were not aware as to the importance of the step they had taken for the future of the Turkish aviation industry. At that time, the Turkish defence research agency, SSM (today SSB), was the driving force behind this move and allocated a budget of US$278,000 which increased to US$828,000 with additional agreements. Later, the UAV-XP succeeded the UAV-X1, but unfortunately, in the following years, no breakthrough was made so it was decided to procure UAVs from the US because of the acute needs of the Turkish Armed Forces. In 1992, US company General Atomics bought the GNAT 750 and it entered service in 1993, but expectations could not be realised. As a result, Turkey ceased with the purchase of foreign-made UAVs through a decision of the Defence Industry Executive Committee. It was decided that the State's goals in this field should be realised through self-development, though shortly before that, the purchase of 10 Israeli IAI HERON UAVs was approved for the transitional period. TAI was commissioned by SSM in 2004 to develop a domestic UAV, however, at the same time, the cooperation with Israel's armament partner for UAVs was intensified. In the case of the IAI HERON, there were clear discrepancies between the two countries. Although the project began in 2005,

Photo: TAI Industries

The AKSUNGUR UAV of TAI Industries is capable of day and night reconnaissance and ISR and attack missions.

Photo: TAI Industries

The AKSUNGUR carrying MAM-L ammunition

it was delayed for technical reasons for a long period of time. Despite delays, the Turkish military was nevertheless confident that deliveries could start in early 2010. Although the Turkish Armed Forces acquired 10 HERONs, as well as ground control and support systems, there was constant bickering over the EO payload. Turkey insisted on using its own AselFlir 300T instead of the Israeli MOSP-3000, arguing that it was a case of 'big brother' watching you. Although the MOSP-3000 weighed a third of the Aselsans AselFlir 300T, it did not offer the capability of laser marking. The Turkish Defense Procurement Authority prevailed and at the same time, work on the develop-

ment of a Turkish UAV was accelerated significantly so as not to be left behind. What follows is an overview of the ecosystem of the Turkish UAV industry.

Propulsion Technology

Turkish Aerospace Industries founded the JV Turkish Engine Industries (TEI) with General Electric (GE) in 1985. The company has been working in recent years on the development and production of engine models, the reason being that in spite of political and economic obstacles, technological developments continue. The export of UAVs with external engines is difficult and therefore SSM placed an order for the development of the TEI-PD170 in December 2012. The engine successfully completed its first test on an ANKA-S UAV in December 2018. It is a 2.1 litre turbo diesel engine with a power output of 172 (±2) hp, the engine generates 170 hp at an altitude of 20,000 ft., at 25,000 ft. 155 hp, 30,000ft 130 hp, 35,000 ft. 105 hp and 90 hp at 40,000 ft. It has enough power to work at an altitude of 45,000 ft. A little later, the PD170 was redeveloped with the TEI-PD222ST, which has 220 (±2) hp with the engine generating 180 hp at an altitude of 20,000 ft. and 115 hp at 30,000 ft.

With the more powerful PD-170 engines and the modification of the wings by removing the flaps and increasing the wing area, the ANKA-S was able to increase its payload capacity from 200 kg to 350 kg and to spend 50% more time at higher altitudes. This meant that ANKA-S was able to prove its capability at an altitude of almost 14 km with the corresponding payload. The TAI engineers have learned to get more out of the ANKA and to integrate the accumulated knowledge into its bigger brother, AKSUNGUR, in a cheap and effective way. The TEI-PD170 and TEI-PD220ST are used as push propellers for the ANKA, and as pull propellers for the AKSUNGUR. The FEDEC engine control system was also developed by TEI and was put into series production after 6,000 hours of testing. On 23 November 2019, TEI delivered 40 PD-170 engines. The TEI PD-series is the property of the SSB and can be upgraded at will on domestic UAVs and easily exported. The TEI is also working at full steam on propulsion systems for future UAVs or for combat UAVs with jet engines. Recently, TEI has developed and presented the rocket engine TEI-TJ300, which is intended to carry rockets, but also to equip UAVs, but TEI has already launched the turbojet engine TEI-TJ90 in 2011 in cooperation with TÜBITAK (Scientific and Technological Research Council of Turkey) and integrated it into target drones in June 2013.

Photo: TAI Industries

The AKSUNGUR UAV can be armed with a variety of air-to-ground weapons.

Baykar Technologies has gone its own way and together with the Ukrainian company, Ivchenko Progress, founded the joint venture BLACK SEA SHIELD, whose first project is the development and production of the AI-450T turboprop engine from 450 hp to 750 hp for the UAV AKINCI. In the future, Turkish UAVs will definitely be equipped with turboshaft and jet engines with very high performance levels. There are two reasons for this: the UAVs will not only be able to fly at higher altitudes with greater payloads, but also able to engage in dogfights.

System Architecture

In 2012, the "Roadmap for the Turkish UAV-Production" was created to meet the needs of the Turkish security forces, Gendarmerie, Police and also the Secret Service. The development of UAVs was therefore given the highest priority with the ultimate goal of becoming independent from foreign countries and to successfully make a name for itself on the world markets.

Many companies are involved in this industry and here are just a select few: CTECH develops ultra-light UAVs (approx. 20 kg) with very compact satellite communication systems that allow for uninterrupted communication with very high data volumes and speed while moving without any distance restrictions. The satellite terminal DEV-KU-12/18/20 inch SOTM (SATCOM-On-The-Move) has data transmission speeds of 20 Mbit/s using the Ku and Ka wave bands. The full-duplex communication link is encrypted using Encryption AES256 FIPS 140-2 technology. In addition, the line-of-sight (LOS) communication system provides reliable and uninterrupted communication with the UAV ground control station in all weather and operating conditions. The real-time transmission of control commands to the UAV during the air-to-ground channel sensor, video and audio data from electro-optical UAV devices to the ground station is operated at well over 200 km distance and at a height of 40,000 ft. ESEN System Integration is a subsidiary of the US aerospace company SNC in Ankara and is involved in the Wide Area Surveillance System (WAS) which provides real-time continuous surveillance capability over a city sized area (~20 km2). Through the utilisation of this system, complete situational awareness is achieved whilst gathering more intelligence data in combination with the Big Data Fusion, Analysis and Decision Support System.

The company Meteksan researches and develops technologies that are optimally adapted to the volume size, weight and power consumption of the UAVs in a minimalist manner, thereby ensuring that the UAV can remain in an operational area for a very long time. To mention some technology, the TMV Telemetry Transmitter enables the telemetry data to be sent under difficult conditions and poor weather conditions. The multifunctional MILSAR, a SAR (Synthetic Aperture Radar) and GMTI (Ground Moving Target Indicator) is under 30 kg and outperforms similar systems on the market in terms of size and functionality. The radar allows it to obtain quality images under all conditions. Images are generated with a resolution of 1 metre and in spot mode, the MILSAR displays an image of the target area with an accuracy of 30 cm. In the near future, a function for detecting coherent changes is planned. The system also features DMTI

Photo: Korhan Özkilinc

A range of armaments for the AKINCI UAV on display

(Dismounted Moving Target Indication) and MMTI (Maritime Moving Target Indication) modes for maritime targets. The Flight Control Computer and the Automatic Take-off and Landing System, as well as the Airborne and Ground Segment OCIS system, enable reliable take-off and landing at the same time and safe flights under all conditions. The radar altimeters CRA-201 and CRA-501 provide accurate altitude data and the Anti Jamming-GNSS suppresses GPS controlled mixed signals during operations. The Anti Jamming GNSS device, which can be operated in the wavebands GPS L1, GPS L2 and GLONASS L1, has a 4-channel antenna and supports the global satellite navigation signals GPS, GLONASS, GALILEO and BIDOU and operates with a wide frequency range. The C-band UAV Data Link, Airborne Omni Antenna and Ground Directional Antenna provide not only secure communications, but also reduces high data transmission speed.

Milsoft company is engaged in developing a complete mission system solution of Ground Control Station GCSMS of UAVs which consists of Mission Planning Software, Payload Control Software, Communications System, Integrated Test and Monitoring Software. Furthermore, it is developing the Mil-INTEL, designed for efficiently and effectively analysing different types of intelligence data. This provides the intelligence organization the opportunity to turn a massive amount of data into actionable high value information. These include 2D/3D Map and Drawing Capabilities, Common Intelligence Picture, Search & Geo-Search, Image Exploitation & Analysis, and Video Drawing & Annotation Capabilities.

The Savronik company develops satellite ground terminals and stations for voice and data transmission in the X and Ku wave range, as well as flight control outside the line of sight for UAVs.

The company Space Defence Technologies (SDT) develops and produces Image Processing and Pattern Recognition Capabilities, for example Automatic Target Detection & Recognition, Classification, Change Detection, Visualization, Video Analytics and Multi-sensor Data Fusion. Furthermore, Hyper-spectral Data Processing and LIDAR Signal Processing, and Spatial Intelligence Management System are this company's key strengths.

Armaments

Armaments for Turkish UAVs are mainly provided by Roketsan and TÜBITAK SAGE. In 2016, Roketsan introduced the MAM-L, a laser-guided smart micro ammunition that has proven to be highly effective in military operations. The 1-metre long MAM-L weighs 22 kg, with a diameter of 160 mm and is capable of neutralising targets at a distance of 14 km at an optimal launch. The MAM-L has a Semi-Active Laser Seeker and different warheads, which include an Anti-Tank Warhead, High-Explosive Blast Fragmentation, Tandem Effective against Reactive Armour or Thermobaric. The Smart Micro Ammunition attacks targets through an Inertial Navigation System/Global Positioning System. The smaller version of the MAM-L is the MAM-C ammunition, which uses fragmentation effects against accumulations, as well as unarmoured vehicles or military installations such as radar systems. This munition has a diameter of 70 mm, is 970 mm in length and weighs only 6.5 kg. It can fly up to 12 km and the impact accuracy is stated as 3 m. The smallest in the bunch is YATAGAN, a miniature ammunition (40 cm in length, weighing just 1 kg) which was presented at IDEF-2019.. YATAGAN can hit targets at a distance of 8 km with a deviation of up to 1 m, thanks to a laser-guided warhead. Due to its size and weight, a UAV can carry several dozen of these and can be used effectively in an operational area for a longer period of time.

Recently, Roketsan began serial production of the L-UMTAS, a highly effective anti-tank missile with an effective range of 14 km. The missiles are 1.8 m long, weigh about 37.5 kg and have laser seekers. The warheads have TANDEM armour piercing warhead against reactive armour High Explosive Fragmentation. The lightest of the anti-tank missiles is the CIRIT, with an effective range of 8 km. It was developed in order to bridge the gap between simple unguided missiles and expensive anti-tank guided missiles.

Photo: TAI Industries

An ANKA-I reconnaissance UAV

The TÜBITAK SAGE equips the Turkish UAVs with heavy bombs or rockets with very long ranges. The TEBER-81 and TEBER-82are laser guidance kits for use on MK-81 and MK-82 general-purpose bombs, also on the MK-84 (2,000 lb), which can reach a range of 25 km at a height of 40,000 feet. Basically, this type of munition converts the Inertial Navigation System (INS), Global Positioning System (GPS) and Semi-Active-Laser (SAL) Seeker. Furthermore, a Wing Assisted Guidance Kit (KGK) converts the existing unguided 1,000 lb MK-83 and 500 lb MK-82 general-purpose bombs into long-range, air to ground smart weapons. These have a capability of precision hitting targets from an altitude of 37 km and at higher altitudes; the target should be hit within 10 m of the target. Finally yet importantly, the Stand-Off Missile (SOM) - the TAI AKSUNGUR and AKINCI will receive advanced cruise missiles capable of hitting targets from more than 200 km distance. Depending on the version, the cruise missiles weigh up to 500 kg, i.e. one AKINCI or AKSUNGUR UAV might be able to carry two. In all probability, combat drones in the future will be equipped with the air-to-air missile, BOZDOGAN (Merlin), and the GÖKDOGAN (Peregrine) both of which are under development.

Photo: TAI Industries

By modifying the wing surfaces, ANKA-S can take 50% more payload and operate for up to 24 hours at altitudes of 35-40,000 ft.

The ANKA UAV

In 2004, the Defence Industry Executive Committee signed an agreement with TAI for the development of a domestic UAV. The first UAV was the ANKA-A which made its first maiden flight in February 2013. In the second phase of the programme, the first flight of the UAV ANKA-B took place in January 2015; this version had a Synthetic Aperture Radar/Ground Moving Target Indicator/ Inverse Synthetic-Aperture Radar, plus an electro-optical Wescam CMX-15. This UAV was subsequently also equipped with weapon systems of the latest generation, e.g. MAM-L ammunition. The ANKA-B is made completely of composite materials and to enable it to operate in winter and at higher altitudes, an anti-icing system was integrated. This made ANKA-B interesting for export countries in colder regions. As early as October 2013, SSB and TAI signed an agreement on the purchase of 10 SATCOM controlled ANKA-S, plus 12 ground stations. The delivery of the first ANKA-S started in 2018 and the order was to be delivered in full by the end of 2020. ANKA-S is also capable of being controlled by the Turkish communication satellites Turksat 4B. The ANKA-S UAV is equipped with the ViaSat VR-18C high-power airborne satellite communications (SATCOM) antenna and a home flight control computer. As with the others, this can be upgraded with MAM-L and MAM-C ammunition, CIRIT, L-UMTAS. In September 2018, an ANKA-S with CATS (Common Aperture Targeting System), IR, HDTV and DI-NIR camera was subjected to rigorous testing. Towards the end of 2019, ANKA received the TEI PD-170 engine developed by TEI, so there is no obstacle to export this Turkish UAV to foreign buyers. The ANKA-S is 8.6 m long, 3.25 m high, with a wingspan of 17.5 m and a maximum take-off weight of 1,750 kg. The dimensions have slightly changed compared to the previous versions and by modifying the wing surfaces, ANKA-S can take 50% more payload and operate much longer (up to 24 hours) at altitudes of 35-40,000 ft. A special intelligence version of the ANKA was delivered to the Turkish Secret Services (MIT) in March 2018 in cooperation with Aselsan and TAI. This ANKA-I version is equipped with the latest ELINT, COMINT and SIGINT capabilities. Formerly, the Turkish Armed Forces operated the COMINT and SIGINT under the Headquarters Genelkurmay Elektronik Sistemler Komutanligi. By a decision of the President of the Republic, this Headquarters, including its electronic location, was subordinated to MIT on 15 May 2012. There are several versions of ANKA and the Turkish authorities are currently holding talks with several countries from North Africa, East Asia, Southeast Asia, the Middle East, Central Asia and South America regarding the sale of the ANKA-S. The Turkish Armed Forces, Gendarmerie and Police have so far received over three dozen units, mainly the ANKA-S. On 25 December 2019, three ANKA-S systems were sold to Tunisia.

The AKSUNGUR UAV

AKSUNGUR is a UAV system of the MALE (Medium Altitude Long Endurance) class based on the ANKA and had its maiden flight on 20 March 2019. It is capable of day and night reconnaissance, surveillance and reconnaissance (ISR) missions as well as attack missions with EO/IR, SAR and SIGINT payloads and a variety of air-to-ground weapons. AKSUNGUR is powered by two PD-220 twin turbocharged diesel engines with 222 hp each. The flight envelope is specified at 40,000 ft and has a wingspan of 24 m and weighs 3,300 kg. Under each wing, there are three hanging brackets to carry ammunition with different weights of 150 kg, 300 kg and 500 kg. With a payload of 750 kg, AKSUNGUR is capable of carrying out offensive and naval surveillance missions for 12 hours at an altitude of 24,000 feet and SIGINT reconnaissance with a 150 kg payload for 24 hours at an altitude of 40,000 feet. At the end of 2020, a record flight of 49 hours was achieved. AKSUNGUR has fully autonomous operational functions, a dual automated flight control system, an encrypted digital transmission channel and an anti-icing system for higher altitudes and cold winter periods. Like the ANKA-S, the SATCOM control system enables AKSUNGUR to cope with large mission radii and features a day camera, an infrared camera, a laser marker, an electro-optical payload combined with laser rangefinder, a SAR, GMTI-ISAR radar and a wide-range surveillance camera for video reconnaissance. The COMINT version has DF, ESM and the ELINT for signal intelligence, as well as a Personal Location Detection System (PLS), V, UHF radio relays and communication service containers for various communication purposes. For the naval patrol missions, it is equipped with SAR, GMTI-ISAR radar, AIS, Sonobuoy and MAD-Boom (Magnetic Anomaly Detector). The GÖKSUNGUR is a late-stage UAV equipped with turbojet propulsion, which will most likely be used as a com-

Photo: SSB

The TEBER-82 munition integrated into the AKSUNGUR drone with high payload capacity is intended to provide critical capabilities to the Turkish Armed Forces.

bat drone with air-to-air missiles. It will have manned-unmanned teaming capabilities, but the drawback is that the delivery of the F-35 JSF has been blocked. TAI already had its first experience on the project around 2010 on the CASSIDIAN TALARION MALE UAV with EADS, which is now Airbus Defence and Space.

The BAYRAKTAR TB2 and AKINCI UAVs

Baykar Makina, which was founded in 1984 as a supplier to the automotive industry by the two sons of the company's founder (one of them the son-in-law of Turkey's President), entered the fledgling market in 2005 with the mini UAV BAYRAKTAR. The company was able to achieve important milestones in UAV technology from 2014 onwards and supplied the Turkish Armed Forces, the Gendarmerie and Police with the tactical UAV BAYRAKTAR TB2, which was primarily designed for reconnaissance missions, but was later converted to the attack mode. The BAYRAKTAR TB2 is capable of carrying out its tasks continuously for 24 hours at an altitude of 27,030 ft and with a range of 150 km. Powered by Rotax engines, producing almost 100 hp, the BAYRAKTAR TB2 has a maximum speed, according to the manufacturer, of about 70 kt. The BAYRAKTAR TB2 has a maximum weight of 630 kg. The original camera was the Wescam (Canada) but exports have since been suspended due to Nagorno Karabakh conflict. This UAV now has a Turkish opto-electronic system supplied by Aselsan. The attack UAVs are equipped with MAM-L and MAM-C ammunition and with Live Broadcast Transfer System (BGAM), real-time image transmission, as well as live transmissions for command posts and central command posts are possible. Currently, more than 140 BAYRAKTAR TB2s are in service with the Turkish Security Forces, Gendarmerie, Navy and Police. In a 2017 deal, Baykar sold a batch of six TB2s to Qatar for US$70M and later sold six to Ukraine. In the meantime, Baykar has completed the maiden flight on 6 December 2019 with its AKINCI UAV. The AKINCI has a wingspan of 20 m, is 12.3 m in length and is 4.1 m high. It can be equipped with a range of different ammunition, air-to-air missiles, bombs and cruise missiles. The UAV also features Artificial Intelligence, SAR radar, AESA radar, satellite communication systems. The 5.5-ton UAV is powered by AI-450C (approx. 450 hp) supplied by the Ukrainian company Motor Sich, though the company intends to equip the UAV with an even more powerful turboprop engine with approx. 750 hp. The UAV's mission duration is set at 24 hours with a maximum service ceiling of 40,000 feet. It appears that the AKINCI is planned to be produced in three versions (different types of engines) with the third UAV already undergoing flight testing. Operational missions will be supported by two SATCOM and LOS systems. The AKINCI also has a fully automatic flight control system and three spare autopilot systems. Ascent and descent functions are fully autonomous, as well as movement and trajectory tracking. Navigation is based on internal sensor data that works without a GPS connection. Baykar is also developing a UAV with turbojet engines, called MIUS (Fighter Unmanned Plane System), to fly 4-5 hours at a service ceiling of 40,000 feet and at a speed of 0.8 Mach. The take-off weight is listed at about 3.5 tonnes with a payload of 1 tonne.

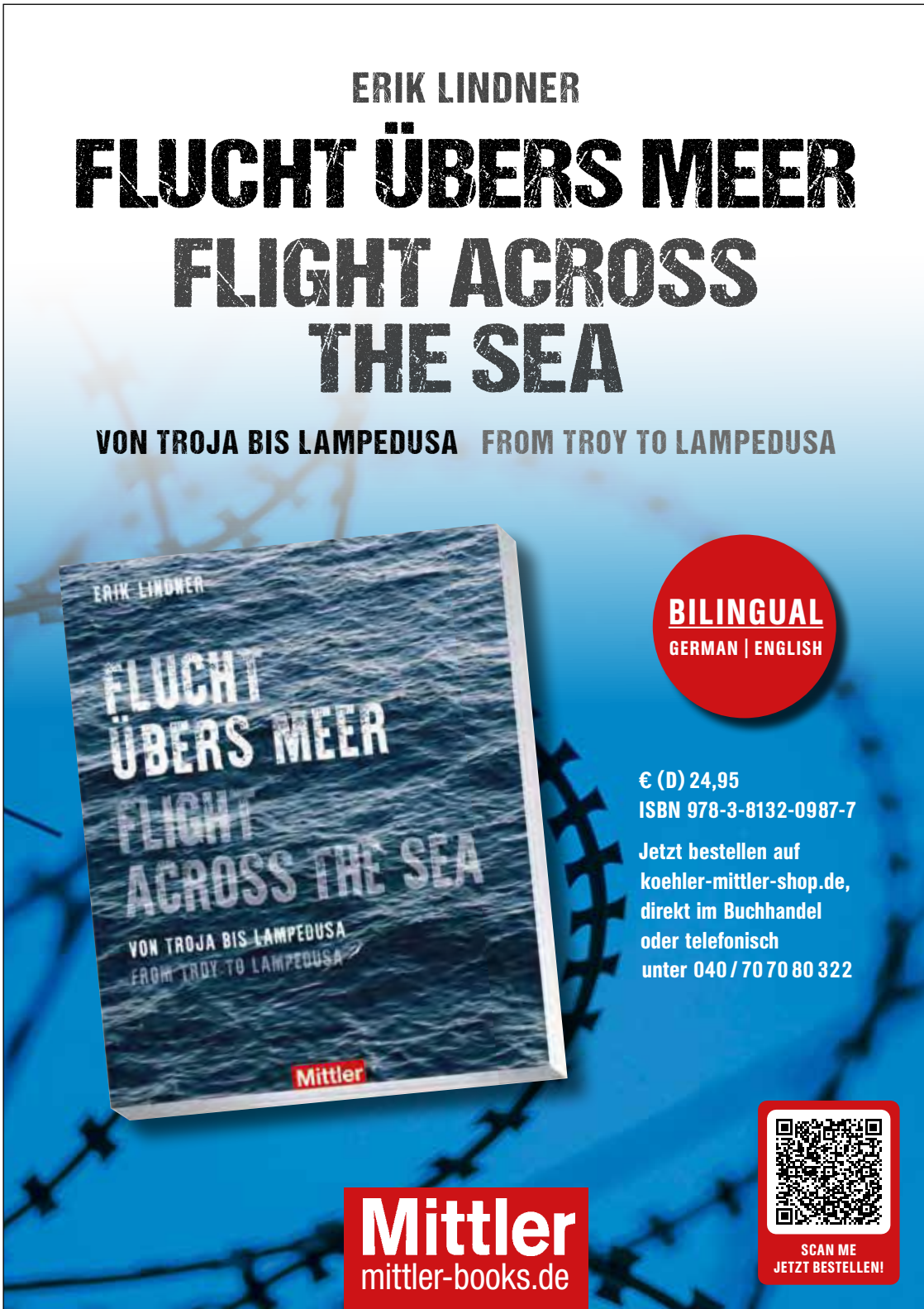
The KARAYEL-SU UAV

Since its foundation in 2003, the company has developed and launched EFE, BORA and KARAYEL UAVs in order of size. The parent company, Vestel, is considered to be the third largest company in Turkey and has several subsidiaries including Ayesas with its extensive knowledge in defence matters, which include avionics design, aerodynamics design, autopilot systems, central control computer and ground control stations. Up until 2010, six tactical KARAYEL UAVs were delivered to the Turkish Armed Forces. These UAVs have been developed and manufactured according to NATO standard STANAG-4671 for surveillance and reconnaissance purposes. The KARAYEL features highly complex systems such as triple redundant distributed avionics architecture designed to provide protection against uncontrolled crashes. As the domestic market is highly competitive between Baykar Technologies and TAI, Vestel Defence has established a foothold in foreign markets with the technically improved KARAYEL-SU UAV. The KARAYEL-SU is slightly larger than the basic version of the KARAYEL, and offers a higher payload capacity in addition to offering a payload for for a Wescam MX-15 EO/IR camera which offers 50x magnification in day camera mode and 30x in infrared camera mode. Furthermore, the system is equipped with a laser rangefinder, laser designer and laser pointer. The KARAYEL-SU is also equipped with a 97 hp engine of Belgian make and weighs 630 kg. The wingspan has been increased from 10.5 m to 13 m, the length is 6.5 m and it can be operational for about 20 hours. There are two weapon brackets under both wings, each of them with a load capacity of 30 kg, meaning a total of 120 kg of different ammunition types can be loaded, especially Roketsan's MAM-L and MAM-C ammunition, in addition to the fuselage, which has a load capacity of 50 kg. Vestel Defence has specified a maximum speed of 80 kt and an operational altitude of approximately 22,500 ft. The range of the Data Link LOS is set to be 150 km. At the Dubai Airshow 2017, Vestel Defence signed a contract with the Advanced Electronics Company (AEC) based in Saudi Arabia for the production of the KARAYEL SU in Saudi Arabia. Later on, the Saudi Arabian AEC exhibited the KARAYEL-SU on its own stand at the Dubai Airshow 2019. Saudi Arabia has deployed the KARAYEL-SU in the conflict in Yemen and in May 2020, the Saudi Arabian General Authority of Military Industries (GAMI) announced the purchase of

46 UAVs from the local defence contractor, which is scheduled to start in the first quarter of 2021 and is expected to cost US$199.5M.

Reliable Pillar of Foreign Policy

It has been said that Turkey has become a "drone superpower", which is not true, but one thing Turkey has achieved, and with considerable effort, is that the value chain for the production of UAVs by the domestic industry has almost been closed, thus ceasing dependence on foreign suppliers. It is certainly true that drones can significantly change the course of conflicts, because they are relatively cheap compared to aircraft, difficult to detect and do not endanger the lives of pilots. This technological development in Turkey has helped Ankara become an important regional power mediator, exerting more influence than before on the outcome of conflicts. The effectiveness of UAVs became very clear in the Syrian civil war in March 2020, which helped stall the Syrian offensive of Dictator Assad on the other side of the Turkish border, allowing for the construction of small settlements for the refugees at the border, thereby significantly mitigating the consequences for Europe. In May of the same year, Turkish UAVs were able to help the Libyan National Army against the forces of rebel leader General Khalifa Haftar, not only to end his offensive against Tripoli, but also to create all-important options at the negotiating table. The Azerbaijani forces were able to destroy over 300 armoured vehicles and as many mobile weapon systems in the second Nagorno-Karabakh war in September 2020 with the help of UAVs supplied by Turkey, pushing the Armenians out of the occupied territories. According to the statements of Azerbaijani President Aliyev, the value of the destroyed weapon systems by UAVs far exceeded US$1Bn. In all conflicts, UAVs have been instrumental in shaping the outcome and will continue to play an important role in the future. The most interesting thing about three successive conflicts is that Turkey has not acted against its geostrategic goals with UAVs vis-à-vis Russia's plans in Syria, Libya and Nagorno-Karabakh, but has strengthened them. Whether the rivalry between the Turkish and Russian Presidents will continue in the current conflict between Ukraine and Russia is questionable, because Turkey plays more of a mediator role in this conflict setting, although Ankara has delivered not only the BAYRAKTAR TB2 UAVs to Ukraine, but will also produce them on-site with Ukrainian companies. Russian Deputy Foreign Minister Sergei Ryabkov made it clear on 13 April 2021, regarding the issue of Turkish drones in Ukraine, that Moscow would not be happy with the presence of these aircraft. It looks like Ankara will expand its drone diplomacy around the world through the export of its UAVs. The Turkish defence industry not only develops UAVs according to the requirements of the domestic armed forces, but also receives enormous feedback from different operational theatres, i.e. that they are "combat proven" from the very beginning. In other words, the enormous efforts that Turkish industries have invested in unmanned technologies form the basic requirement for the future combat domain, namely the "Digital Battlefield". ■



An Astounding Turnaround

Photo: Aeromaritime Systembau

A year ago, Aeromaritime Systembau GmbH, a company with a long-standing tradition in naval shipbuilding, was teetering on the brink of bankruptcy. With harsh measures and under the stewardship of a former submarine commander, the company staged an amazing rebound. ESD had the opportunity to talk to newly appointed Jan Molter, Managing Director of Aeromaritime.

ESD: Only about a year ago, there were reports about Aeromaritime being in financial difficulties. In February 2021, you celebrated the company's 50th anniversary. What is the company - and what are its employees - like today?
Molter: Indeed, the last few years have not been easy, but with cross-divisional cost-cutting measures and the consistent implementation of current orders, we have returned to calmer waters, so that today's prospects look extremely good. We are recording new orders in all areas and intend to use this momentum to take further forward-looking steps. We are filling key positions with new personnel in order to generate sustainable growth again in the future. For this reason, we are looking in particular for systems engineers, qualified technicians, technical sales staff and software developers, to strengthen our project teams, but also for management positions. As you can imagine, these prospects are also very well received by the 60 employees currently working at our Neufahrn and Chemnitz sites. The mood in the teams is correspondingly positive.

ESD: How has Aeromaritime developed over these 50 years? What are the company's core capabilities today? Who owns the company?
Molter: Aeromaritime was founded in Munich on February 7, 1971. The decisive reasons for the choice of location were, on the one hand, the availability of highly specialised personnel and, on the other hand, the proximity to Munich International Airport, which allows us to always provide on-site customer service worldwide within 24 hours. For 20 years, we have been located at our current site in Neufahrn near Freising and thus even closer to Munich Airport. From a small trading company we have grown to be a globally recognised system house for naval communication.
We have had an eventful 50 years, partly because things are rarely straightforward in the project business. This is particularly true of the marine business. In the first 40 years, we were almost exclusively active internationally. For example, we were able to realise our very first order for a complete system in Singapore - a very demanding customer, by the way. The German Armed Forces did not join us as a customer until 2009 with the F-125 class frigates, and this marked the beginning of a very turbulent period, which was also characterised by late payments to us. For a medium-sized system house, this is very difficult to cope with, and we reached our financial breaking point several times.
On the subject of core competencies: The area of "Integrated Communication Systems (ICS) for submarines and military surface vessels" is by far the strongest in terms of sales and will remain so in the future. However, we are the world market leader with our submarine antennas for conventional submarines and also a leader in the Arab region with secure message handling systems (SAMMS). These businesses are significantly smaller compared to ICS complete systems, but are very attractive due to their niche and volume character with few competitors.
Our main core competence lies in full systems integration. With the F-125 frigate, we have delivered a communications system that is unparalleled anywhere in the world in terms of both complexity and system stability since it is a complex open system as opposed to the conventional black box of competitors allowing continuous development through nodes when needed.
Aeromaritime is a privately-owned family business. With the help of continuous financial support from shareholders, it has come through the last difficult years relatively unscathed.

ESD: What impact has the current pandemic had and is having on your business? What precautions have you taken?
Molter: In March 2020, positive Corona cases occurred among some employees and/or their families (fortunately none critical), whereupon we immediately closed the premises in Neufahrn for several weeks. Of course, we took further precautions (setting up a Corona Task Force, mandatory masks, plexiglass screens in the work and reception areas, further hygiene measures, etc.), but overall we came through the crisis relatively well, partly because our building in Neufahrn had enough and sufficient areas to ensure appropriately large distances between individual employees without any problems.
On the other hand, the military project business has a long-term orientation anyway and was less affected by the pandemic than other sectors of the economy.
We would have liked to celebrate our milestone birthday on 7 February, the day of our founding, but due to the tense

Covid-19 situation, we decided to postpone the celebration to the penultimate week of September. We will be happy to hold the celebration with our customers, friends and families, and it should potentially provide a welcome alternative to Munich's Oktoberfest, which is not yet clear if it will even take place.

ESD: Which military programmes at home and abroad can you refer to as a reference? What is the current focus of your business?
Molter: In the 50 years of our existence, we have delivered over 650 systems to more than 45 navies worldwide. Our most important reference today is certainly our Advanced Platform Communication System (APCOS-4000), which is used on the F-125 class frigates for the German Navy. Here we are the system provider for the entire internal and external communications, the Digital Communication Network (DKN) of the ships. This has been a focus of our work in recent years, although APCOS is also successfully deployed in many other countries, both on surface platforms and on submarines. As examples we would like to mention the Norwegian FRIDTJOF NANSEN class frigates and 214 class submarines, as well as the SCORPÈNE class in various countries. Our systems are mostly completely controlled by our own, very stable running software - Communication System Manager (COSYMA).
Today, fortunately, the submarine antenna business is also growing significantly again. As market leader for submarine antennas we are represented on more than 150 platforms worldwide. For some time now, our development department has been working very intensively on the next generation, so that we will be able to start the market launch at the end of 2021.
Furthermore, we also focus on the secure message handling system SAMMS, which is used in more than 400 platforms and in maritime shore stations worldwide. You will find our reliable systems mainly in the Gulf region, but also in many other countries, such as Norway. We are working at full speed on the successor systems generation 8 in order to be able to start again with extensive sales commitments after the pandemic has been contained.

ESD: The international market in the field of ship communication is highly competitive. How do you hold your own against the "giants" of the industry?
Molter: Our decisive advantage lies precisely in the fact that we are not a "giant". The size of our company enables us to develop individual solutions for our customers and to implement them quickly thanks to flat hierarchies and short communication paths. Compared to the large system houses, which usually offer a "black box" from a single source, our customers can integrate any device from any manufacturer into our systems. This means that our individual solutions are usually also very attractive in terms of price, because our customers only have to install what they really need.
Our systems are particularly characterised by high system stability. This point in particular is often decisive in the naval business and ultimately led to us winning system responsibility for communications for the F-125 frigates in Germany against other "giants".

Photo: Aeromaritime Systembau

Aeromaritime is under contract for the Integrated Communication Systems (ICS) for the German Navy's F-125 frigate.

ESD: What technological trends do you have in mind for the future? What will be new at Aeromaritime in ten, twenty years?
Molter: Digitalisation is, of course, also an important issue for us, which is why we are already positioning ourselves accordingly today. When hiring new employees, especially in the area of software development, for example, we have to set the very highest professional standards in order to remain competitive. Naval shipbuilding in particular is also very conservative in its approach, so it is sometimes better for a device with just a few buttons to work perfectly well in a saltwater environment than for it to offer hundreds of configuration options that are mostly not needed and end up rather destabilising the overall system.
Over the next few years, we will continue to develop our systems and products to the latest technological standards, always keeping our ear close to the customer. The next generation of submarine antennas, equipped with additional frequency bands and with new functions, is already under development. In addition, we are working very closely with BAE-Systems on the software adaptation of our message handling systems SAMMS-7 and SAMMS-8. Together we will set new standards in the future.
Our core business will continue to be system control with APCOS and the associated COSYMA software. Both will still be in use on many naval vessels worldwide in 10 or even 20 years. You can be sure that at the 60th anniversary celebration in 2031, we will be able to present the modernised versions of our products, which will then have been heavily digitised but will still be characterised by robustness, stability and maximum customer benefit.

The interview was conducted by Jürgen Hensel.

Jan Molter (53) has been Managing Director of Aeromaritime Systembau GmbH since April 1, 2021. Previously, he served as Sales and Division Manager, as well as Managing Director in various companies in the military project business with a mainly maritime environment. He spent 14 years as a temporary soldier in the German Navy, most recently as Lieutenant Commander and Commanding Officer of the submarine U15.

Naval Programmes in the Eastern Mediterranean

Conrad Waters

The discovery of significant energy resources in the Eastern Mediterranean has served to fuel long-standing tensions amongst countries bordering its waters. These strains have been exacerbated by the Turkish President Erdoğan's desire to expand its regional influence, an ambition that has been supported through the active deployment of an increasingly powerful navy.

When considered against the backdrop of broader political instability extending from the Black Sea through the Middle East to North Africa, it is unsurprising that regional naval procurement is as active now as at any time since the Cold War's end. This article analyses the programmes and plans of the region's four major fleets.

Photo: US Navy

The Turkish Navy has become a leading maritime power in the Eastern Mediterranean. Here the MILGEM type corvette BURGAZADA is seen exercising with the MEKO 200-TN class frigate BARBAROS in 2020.

Turkish Naval Ambitions

The Turkish Navy is arguably the leading maritime power in the Eastern Mediterranean. It maintains a powerful fleet of both seagoing and coastal surface combatants supplemented by Europe's largest submarine flotilla. The attention devoted to the Turkish Navy is partly attributable to the country's strategic position controlling transit from the Mediterranean to the Black Sea through its command of the Bosphorus and Dardanelles, along with the need to protect the security of its maritime interests in both these seas. There is also a strong imperative to maintain a balanced fleet comprising both littoral and blue water assets given the varying maritime environments in which the navy is required to operate.

Turkish naval construction has followed a similar trajectory to that seen in many emergent economies, with the acquisition of warships from abroad followed by the licensed construction of foreign designs. This process has resulted in particularly strong links with the German shipbuilding sector. The navy's MEKO 200-TN series of frigates, AYDIN class mine countermeasures vessels and all of its existing fast attack and submarine classes are of German origin, albeit with many of the vessels subject to local assembly. Collaboration between Germany and Turkey continues in the form of the current Type 214-TN REIS class submarines. Six of these are in the course of construction at the Gölcük Naval Shipyard to a modified Thyssen-Krupp Marine Systems (TKMS) air independent propulsion (AIP) Type 214 design. The contract for the €2.1Bn programme was first agreed in 2009 but implementation has been slow, possibly due to a desire to incorporate significant amounts of Turkish-manufactured equipment into the new boats. The lead submarine, PIRI REIS, was finally launched on 22 December 2019 and she is expected to become operational in the course of 2022. The other five members of the class are then expected to follow at annual intervals. Local sources suggest that completion of the programme will be followed by a project for a fully national "MILDEN" submarine.

The desire to develop a full indigenous submarine design and manufacturing capability reflects a similar process that is already evident in the development of Turkey's surface fleet. The "poster boy" for this national naval effort has been the MILGEM – an acronym of the Turkish word Milli Gemi (national ship) – programme for four corvettes. First originating in the late 1990s, this was intended to establish the industrial and technical capability required to design, manufacture and integrate a complex warship. As well as seeking to drive Turkey's naval capabilities, the programme had a key economic objective in terms of expanding the potential of the country's naval defence industry.

Author

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Despite several significant challenges, four ADA class MILGEM variants were delivered by Istanbul Naval Shipyard between 2011 and 2019. Attention has now turned to the evolved and enlarged "I" class frigates, four of which are also planned. The lead ship, ISTANBUL, was launched on 23 January 2021 and is expected to enter service in 2023. Completion of this programme should, in turn, allow implementation of long-awaited plans to construct a class of much larger TF-2000 air defence destroyers. Design work on these ships commenced in 2017 and should be informed by the current mid-life upgrade of the MEKO 200-TN Batch 2 BARBAROS class frigates that is being led by Turkish defence conglomerates ASELSAN and HAVELSAN. Meanwhile, the economic benefits sought from the national ship programme have been demonstrated by Pakistan's selection of the ADA design as the basis for a quartet of its own corvettes, two of which are being assembled at Karachi Shipyard and Engineering Works with Turkish assistance. Recent reports also suggest that Ukraine is also close to acquiring ADA-type vessels, whilst the design has formed the basis for the new intelligence gathering ship UFUK, which started sea trials in mid-2020.

One aim of the MILGEM programme that has yet to be fully realised is the expansion of complex warship construction into Turkey's large network of private shipyards. However, the privately-owned Sedef Shipyard has been given responsibility for the Turkish Navy's most prestigious shipbuilding programme in the form of the new LHD type amphibious assault

Photo: Turkish Navy

The MILGEM programme has been in the forefront of developing indigenous Turkish warship design and construction capabilities. This is the second ADA class MILGEM variant BÜYÜKADA.

Photo: Hellenic Navy

Greece's financial woes have significantly impeded naval modernisation. The sixth ROUSSEN class fast attack craft KARATHANASIS was delivered in mid-2020 after years of delay.

Photo: US Navy

The mid-life modernisation of the Hellenic Navy's four MEKO 200-HN HYDRA class frigates forms a key part of current fleet enhancement plans. This is PSARA in March 2021.

ship ANADOLU. Constructed in alliance with Spain's Navantia as a modified variant of the Spanish Navy's JUAN CARLOS I, completion of the project is expected in the course of 2021 in spite of delays resulting from an onboard fire in April 2019. The ski-jump equipped ship was destined to be equipped with F-35B Lightning II STOVL strike fighters to provide the navy with an aircraft carrier-like capability. However, the US decision to eject Turkey from the F-35 programme following the Erdoğan administration's decision to acquire Russian S-400 surface-to-air missiles means that these plans are on ice. Turkish industry has already delivered a number of tank landing ships and smaller tank landing craft in recent years, with additional units planned.

Another important project entrusted to the private sector is the construction of a new replenishment vessel at Sefine Shipyard under a contract signed in July 2018. More details of the ship emerged in mid-2020 when GE announced it had been selected to provide two LM-2500 gas turbines for the ship. Her delivery, anticipated before the middle of the decade, will significantly extend the fleet's ability to project power at greater distance from its home bases. However, littoral warfare is not being ignored with an indigenous fast attack craft (FAC) programme amongst the latest to be launched. This will be based on an entirely national design derived from STM's FAC-55 concept.

A Greek Revival?

In contrast with the Turkish Navy's steady process of qualitative improvement and higher levels of indigenisation, Greece's Hellenic Navy has essentially stood still as a result of the country's financial problems of the past decade. The start of the new millennium saw the Hellenic Navy in a relatively strong position. Programmes for new Type 214-HN AIP-equipped submarines and ROUSSEN (British SUPER VITA) class fast attack craft offered the prospects both of substantial upgrades of surface and sub-surface capabilities and the further expansion of the naval industrial base through significant elements of licensed production in local yards. Subsequent contractual disputes with TKMS over allegations of design deficiencies

Eastern Mediterranean Naval Procurement: Selected Programmes

Warship Type	Warship Class	Supplier	Ordered	Completed	Under Build	Planned
Turkey						
Corvette	MILGEM/Ada	Istanbul Naval Shipyard	c. 2005	4	0	0
Submarine	Type 214-TN	TKMS/ Gölcük Naval Shipyard	2009	0	6	0
Amph. Assault Ship	ANADOLU	Navantia/ Sedef Shipyard	2015	0	1	0
Frigate	MILGEM/ISTANBUL	Istanbul Naval Shipyard	c. 2017	0	1	3
Destroyer	TF-2000	To be Advised (TBA)	TBA	0	0	Up to 7
Greece						
Submarine	Type 214-HN	TKMS/Hellenic Shipyards	2000 onwarsd	4	0	0
Fast Attack Craft	ROUSSEN	BAE Systems/Elefsis Shipyards	2000 onwarsd	6	1	Up to 2
Frigate	TBA	TBA	TBA	0	0	4
Israel						
Submarine	DOLPHIN (Batch 2)	TKMS	2006 onwards	2	1	0
Corvette	MAGEN	TKMS/GNY Kiel/Israel Shipyards	2015	0	4	0
Fast Attack Craft	RESHEF	Israel Shipyards	TBA	0	0	Up to 8
Submarine	DOLPHIN (Batch 3)	TKMS	TBA	0	0	3
Egypt						
Submarine	Type 209/1400	TKMS	2011 onwards	3	1	0
Corvette	"Gowind 2500"	Naval Group	2014	2	2	0
Frigate	FREMM – French Variant	Naval Group	2015	1	0	0
Amph. Assault Ship	MISTRAL	Naval Group	2015	2	0	0
Corvette	MEKO A200	TKMS	2018	0	0	4
Frigate	FREMM – Italian Variant	Fincantieri	2020	1	1	0

with the lead – and only German-built – Type 214-HN submarine PAPANIKOLIS followed by the onset of financial problems that impacted local shipyards associated with both projects essentially served to derail these ambitions. Deliveries of the remaining quartet of submarines from Hellenic Shipyards were eventually concluded in 2016, whilst the Elefsis yard is now close to delivering the seventh and final ROUSSEN. However, the Hellenic Navy has clearly fallen behind its main regional rival at a time when tensions with Turkey have mounted.

The most urgent requirement is recapitalisation of the navy's flotilla of major surface combatants. The existing four MEKO 200-HN and nine former Dutch ELLI ("Standard") class frigates are all well in excess of 20 years old and in need of modernisation or replacement. As part of wider plans for a major upgrade of the country's armed forces announced by Greek Premier Kyriakos Mitsotakis in September 2020, the MEKO 200 type vessels will benefit from major midlife modernisation whilst four new, multi-role surface combatants will be acquired. In late 2019, Greece had signed a letter of intent to purchase two "Belh@rra" export variants of Naval Group's Frégate de Défense et d'Intervention (FDI). However, it seems that a wider portfolio of designs is now under consideration for the enlarged contract. Much may depend on the industrial strategy adopted to support construction, including the priority attached to ambitions to revitalise the Hellenic and Elefsis shipyards under new ownership.

Pending selection of a preferred contractor, the Hellenic Navy is also taking steps to address other deficiencies. In October 2020, a contract for four MH-60R SEAHAWK helicopters was placed with Lockheed Martin. The following month saw a long-delayed agreement to acquire 36 SeaHake mod 4 torpedoes from Atlas Elektronik to equip the Type 214 submarines. There have also been local press reports that construction of the ROUSSEN class may be extended to encompass another two units, although a proposal from Israel Shipyards for the licensed production of a THERMISTOCLES variant of its SA'AR 72 design provides another potential option. In any event, Greece has much to do to make up the ground lost to its Aegean rival.

Photo: TKMS

Israel's MAGEN class corvettes are being fabricated in Germany but outfitted "in country" with Israeli combat systems with the help of Israel Shipyards.

Israeli Modernisation

Meanwhile, Israel Shipyards is benefitting from a significant modernisation of Israeli Navy capabilities as the increasingly evident need to secure the country's own offshore energy resources has expanded the importance of a service that has historically been accorded a lower priority than the other branches of the country's armed forces. As a result, the company is heavily involved in projects that will see the wholesale replacement of the fleet's major surface units with vessels that are better suited to protecting the country's interests in its exclusive economic zone (EEZ).

The centrepiece of this initiative is a flotilla of four SA'AR 6 or MAGEN class corvettes that were ordered from TKMS with German financial assistance in 2015. With a displacement in the region of 2,000 tonnes and a length approaching 90 metres, the corvettes are significantly larger than existing Israeli surface combatants and thus better suited for extended deployments. The ships are being assembled in Germany by German Naval Yards Kiel to a design reportedly derived from the K130 BRAUNSCHWEIG class. How-

Photo: Crown Copyright 2020

The Egyptian Navy has undergone a remarkable period of expansion. Here the veteran frigate SHARM EL SHEIKH exercises with the new amphibious assault ship ANWAR EL SADAT.

Photo: TKMS

The Egyptian flag is raised over the submarine S43 for the first time in April 2020. Current Egyptian modernisation efforts can be traced back to orders for Type 209/1400 submarines almost a decade ago.

ever, much of the programme's cost relates to outfitting the vessels with largely indigenously manufactured weapons and electronic systems. This process will be completed by Israel Shipyards, who will also subsequently be responsible for maintaining the corvettes in a new floating dock specially built for the purpose. The lead ship arrived in home waters in December 2020 and is scheduled to enter operational service in 2022.

The SA'AR 6 corvettes will eventually be supplemented by a class of smaller SA'AR 72 RESHEF class vessels for which Israel Shipyards were awarded a design contract towards the end of 2019. These ships are intended to replace the navy's eight existing 62 metre SA'AR 4.5 fast attack craft that were delivered over the course of two decades from the early 1980s onwards. They are likely to share many locally developed systems with their larger MAGEN class counterparts. Although no official details have been released, it seems reasonable to assume that eight of the new ships will eventually be built, thereby maintaining overall force numbers as the old craft decommission.

The other major element of Israel's fleet modernisation relates to its submarine flotilla. This is widely reported to have a strategic function through an ability to deploy nuclear-armed cruise missiles. The force also has an undoubted value in the fields of intelligence gathering and other covert operations. The coming months will see completion of the navy's second, AIP-equipped batch of the German-built DOLPHIN class submarines with the delivery of DRAKEN from TKMS in Kiel. The third of the batch, she will become the sixth member of the overall class. A memorandum of understanding agreed between Israel and Germany in 2017 envisages the completion of a third batch of three submarines over the course of the current decade, which will ultimately replace the first trio as they fall due for withdrawal. As is the case for other recent contracts agreed with German shipyards, the memorandum envisages the German government subsidising a third of overall construction costs.

Photo: Israel Shipyards

The design of Israel's planned SA'AR 72 RESHEF class has been allocated to Israel Shipyards.

Egyptian Expansion

The most remarkable programme of regional naval expansion currently underway is that being undertaken by Egypt. In common with Turkey, the country occupies a position of immense maritime strategic influence, in this case by virtue of its control over the Suez Canal. Long focused on the defence of the waterway and its immediate approaches, the Egyptian Navy has recently benefitted from a major surge in investment that has transformed it into an instrument of regional influence with meaningful expeditionary capabilities. Much of this expansion has been directed with an eye to the waters south of the canal. Indeed, some view the enlarged fleet as providing a proxy force for Egypt's regional allies in the ongo-

ing stand-off in Iran. However, just like its more northerly maritime neighbours, Egypt also has substantial energy interests in its Mediterranean offshore waters that require protection. The recent cooling of relations with Turkey, exacerbated by Turkish involvement in Libya's civil war, has doubtless provided an additional incentive to build a strong navy.

It is notable that recent Egyptian naval procurement differs from that undertaken by the other major regional navies in two significant aspects. One of these is the seemingly short term, almost opportunistic, nature of many Egyptian programmes. This is also reflected in the varied national origins of the suppliers supporting naval expansion. Current modernisation efforts can be traced back to the order for two Type 209/1400(mod) submarines from TKMS in 2011, a project subsequently bolstered by the exercise of options for a pair of additional boats in 2015. By this time, attention had shifted to surface fleet modernisation, which was initially carried out in conjunction with what is now the French Naval Group. Orders for a quartet of GOWIND type corvettes were quickly followed by "off the shelf" purchases of a single French FREMM type frigate and the two MISTRAL class amphibious assault ships originally built for the Russian Navy but put on the market when the deal collapsed following the Crimea annexation. However, subsequent warship acquisitions – for four newly-built MEKO A200 frigates from TKMS and two Fincantieri-built Italian FREMM variants originally destined for the Italian Navy – will result in a less than homogenous fleet mix. The motivation behind this selection of diverse suppliers is seemingly driven by a desire to ensure security of arms imports by avoiding over reliance on any one country. The cost of the additional training and logistic support burden that this approach will inevitably entail is seemingly considered a price worth paying.

Another notable aspect of recent Egyptian warship programmes has been the relatively low priority attached to using naval investment to bolster the domestic shipbuilding sector. Three of the four Naval Group GOWIND corvettes are being assembled at the Alexandria Shipyard (ASY). The facility delivered the first of the indigenously built ships, PORT SAID, on 6 January 2021 and has already launched the two other units. In September 2020, ASY also revealed that it had been allocated responsibility for constructing one of the MEKO A200 frigates ordered from TKMS. However, in general terms much of the Egyptian Navy's expansion has been driven by the acquisition of "off the shelf" ships completed in foreign yards, whilst efforts to develop indigenous upgrade and equipment manufacturing facilities in similar fashion to Turkey have also been largely absent. This seems to be a missed opportunity.

Recent investment has undoubtedly radically expanded the Egyptian Navy's potential but reports circulating at the time of the Italian FREMM acquisitions suggest that more ships might be obtained as part of a wider armaments deal said to amount to as much as €10Bn. However, Egyptian procurement plans are notoriously opaque and there is also the question as to whether the fleet's training organisation would be able to support further growth. However, the more fundamental question is whether the lack of an underlying industrial strategy means that the Egyptian Navy's undoubtedly impressive leap forward is built on much shakier foundations than the slower but deeper rooted approach adopted by some of its regional neighbours. ■

Masthead

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"We are ready for new global partnerships"

Photos: Aselsan

With a workforce of 3000 engineers and more than 5500 employees, ASELSAN enjoys a position as one of the leading pioneering technology companies in Turkey. The company provides innovative value-added products and solutions to its customers at home and abroad, especially to the Turkish Armed Forces. ESD had the opportunity to speak with Prof. Dr. Haluk Görgün, Chairman, President and CEO of ASELSAN.

ESD: ASELSAN was established in 1975 and approaching its 50th anniversary. Where does the company sit in the overall Turkish security/defence industrial structure?

Prof. Görgün: The defence industry is one of the most critical sectors for a country's security. As Turkey is located between Europe and the Middle East, our strategic geopolitical position requires a strong defence infrastructure. In line with the vision of having a defence industry fulfilling our Army's needs, we have developed various solutions employing state-of-the-art technology.

Our starting point in 1975 was to establish a local technology centre addressing Turkey's needs in the defence industry. With nearly 50 years of experience, we are now the largest Turkish defence contractor and ranked 48th in the world Top 100 Defence Companies List.

ESD: The company's motto is "Technology Serving People and Planet". In the security and defence domains, what are your personal, favourite examples that support this description?

Prof. Görgün: Over the years, we have placed major emphasis on technology development and have adopted innovation as the cornerstone of our business. We see technology as an opportunity for creation that addresses both people's and the planet's needs.

We have also continuously invested in emerging technologies. In line with this, we have focused and invested in the healthcare sector to deploy innovative solutions tackling the healthcare challenges of today. The coronavirus pandemic has changed both the social and commercial life throughout the world and Turkey is one of several countries that has developed fast and decisive initiatives proven to be effective in reducing the viral spread. We joined a consortium for national ventilator production and maximised our efforts in mechanical, software and electronic design with our strong engineering capabilities and advanced technological infrastructure to tackle the challenge.

Furthermore, as a company which is also implementing energy projects, we prioritise our environmental awareness in areas such as reducing waste and minimising carbon emissions and footprint. As a result of our sensitivity in this area, we have been awarded the highest score by the Carbon Disclosure Project (CDP).

We are also engaged in climate change mitigation; we view climate change not only as a risk factor, but also as an opportunity for widening our environment and user-friendly solutions. In short, we shape technology so that it creates value

Aselsan continues to be at the forefront in Turkey's technological independence efforts.

The Turkish Armed Forces have increased operational capability and minimised their foreign dependency by use of Aselsan's indigenously developed high-tech systems on many platforms.

for people: for our clients, our partners and our employees.

ESD: How was 2020 for ASELSAN and what are ASELSAN's priority programmes going forward? How do you see the company's growth into the next few years?
Prof. Görgün: Although the impact of the pandemic is felt in every field, I am very proud to say that we achieved record international sales figures in 2020. Our international sales are reflecting a remarkable upward trend, while we are breaking our own records year after year. On the other hand, we continue investing in our global engineering and manufacturing centres such as in Ukraine, Qatar and Pakistan. Our MRO Centre based in Qatar has been recently launched and is offering after-sales support services not only for Qatar but also other regional clients as well.
Within the next few years, we are targeting growth in global markets, while increasing our local presences in promising locations. Being a client-oriented technology company, we believe that it is vital to keep pace with evolving requirements and client expectations. In line with this concept, we have undertaken a transformational and localisation strategy, combined with organisational restructuring in order to maintain a competitive edge and better serve ASELSAN users.
We are ready for new global partnerships, aligned with our corporate strategy. We would also like to foster our partnerships with governments that are planning and developing local programmes. Apart from this, we will continue to focus on localisation activities through local production, transfer of technology programmes, local maintenance, repair and overhaul centres supported by our local offices and joint ventures worldwide.
In addition to our commercial product lines, spanning from medical equipment to smart transportation, we will continue to expand and reach out to the people in more than 70 countries.

ESD: How do you manage the professional development of people within ASELSAN?
Prof. Görgün: ASELSAN is a big family. First of all, we ensure that our family members are well aware of the fact that their every effort is recognised and appreciated. This approach has seen us ranked as the number one employer in Turkey according to the Harvard Business Review Turkey's report.
Additionally, we highly value the professional development of our employees, so much so that "Improve yourself, improve your team, enhance your organisation" is the motto that lies at the heart of our corporate values. We place much emphasis on development throughout various HR processes and practices.
We have also built a customised competency model and defined the behavioural, managerial and technical competencies that should be achieved by ASELSAN employees at different seniority levels and in different fields of activities.
Furthermore, we employ a performance management system based on the continuous feedback and development process. Within the talent retention and succession management, we define various career development paths in order to turn our employees' potential into real value for our organisation. We believe that learning is a never-ending journey so we are investing in novel learning and development tools and processes.

ESD: How much internal R&D does the company undertake?
Prof. Görgün: We are one of the largest R&D centres in Turkey. Our R&D and engineering staff constitute 60% of our total headcount (around 5,200 people). Relative to our 2020 revenue figures, our R&D spending was around 21%, (US$418M) a significant figure which shows our strong commitment to the technological growth and innovation.
Each year, 7% of the previous year's revenue is allocated for internally funded R&D projects. In 2020, there were around 200 internally funded R&D projects in ASELSAN.

The interview was conducted by Stephen Barnard.

A Look at Turkish Armament Programmes

Kubilai Han

Exporting its defence products to 70 countries, Turkey has become the world's sixth largest exporter in terms of defence and aerospace systems. On 9 February 2021, Industry and Technology Minister Mustafa Varank disclosed that Turkish Defence & Aerospace Industry had achieved a turnover of over US$11Bn, 30% of which was obtained through exports.

According to "Strategic Plan 2019-2023" issued by the procurement authority SSB on 4 December 2019, the Defence and Aerospace Sector's annual turnover will rise to US$26.9Bn from US$8.761Bn in 2018, defence and aerospace (both military and commercial) exports to US$10.2Bn. The local content rate in defence projects will reach 75% by 2023 - the year that marks the first centennial of the Republic of Turkey. According to current estimates, local content reached 70% in 2020.

Major MoD Projects

Whatever Turkey's Defence & Aerospace Industry has produced for the Turkish Armed and Security Forces, the country has been able to sell internationally.

ALTAY Main Battle Tank (MBT)

The €3.5Bn ALTAY MBT Series Production Phase Contract was signed between SSB and prime contractor BMC on 9 November 2018. It covers the production and delivery of 251 tanks in three different configurations; 40 T1, 210 T2, and 1 T3 prototype with an unmanned turret. However, although 28 months have passed since the signing of the agreement, the contract could not enter into force due to problems in the procurement of critical subsystems including German Europowerpack. A domestic 1,500 hp powerpack named BATU was planned to be used in some ALTAY MBTs and for this purpose, SSB signed a contract with BMC Power on 13 June 2018. On 24 March 2021, Mesude Kilinc, Head of SSB Department of Engine and Power Transmission Systems, declared that the acceptance test of the BATU National Powerpack System will take place in 2024. First test runs with the domestic 1,500hp V12 diesel engine took place in April 2021. Meanwhile, after failing to receive an export licence from the German Government for the Europowerpack to be installed on ALTAY MBTs during the last three years, Turkey has recently started negotiations with South Korean tank engine manufacturer Doosan Infracore Corporation (1,500 hp rated 12-cylinder DV27K diesel engine) and the transmission manufacturer S&T Dynamics (EST15K automatic transmission) through the South Korean Hyundai Rotem to save the ALTAY MBT Series Production Phase contract.

Author

Kubilai Han, is a freelance expert on regional defence matters based in Istanbul, Turkey.

Photo: Author

The ALTAY T1 MBT technology demonstrator is based on the ALTAY PV2 prototype with many dummy subsystems.

ISTIF Class Frigates

The ISTIF class frigate programme was launched to construct four frigates, the enhanced version of ADA class corvettes, to replace aging YAVUZ class frigates by mid-2020. Istanbul Naval Shipyard is responsible for the design and the prototype ship construction. Launched on 23 January 2021 at Istanbul Naval Shipyard, the first ship of the class, TCG ISTANBUL (F-515) is scheduled to start Sea Acceptance Tests (SATs) in January 2023 and is planned to enter Turkish Naval Forces' (TNF) service on 6 September 2023.

TCG ANADOLU Multipurpose Amphibious Assault Ship (LHD)

Under the Multipurpose Amphibious Assault Ship (LHD) Project Contract signed on 1 June 2015 between SSB and Sedef Shipbuilding Inc. (Sedef Shipyard), the Keel Laying Ceremony of TCG ANADOLU (L-400), planned to be constructed with 68% domestic input, was held on 30 April 2016 at Sedef Shipyard in Tuzla, Istanbul and the project activities were started as of 18 September 2015. TCG ANADOLU LHD was launched in May 2019 and Harbour Acceptance Tests were performed in 2020. The outfitting efforts on the ship are currently ongoing. The vessel was planned to be inducted into the Turkish Navy (TNF) late 2020, but this deadline was extended until the end of 2022. In March 2021, SSB disclosed that the ship would carry UAVs and Unmanned Combat Aerial Vehicles (UCAVs), along with helicopters and armoured land vehicles. For this purpose, structural modifications on the flight deck and the ski-jump ramp in front and upgrades will be carried out to allow take-off, landing and hangar operation on the ship to operate UAVs and UCAVs.

TF-2000 Air Defence Warfare (ADW) Destroyer

TNF has initiated a project called TF-2000 to construct a total of four (+2 optional) destroyers fitted with enhanced anti-air weapon and sensor systems. The main aim of this project is to acquire fleet area air defence capability. The TF-2000 Air Defence Warfare (ADW) Destroyer is expected to have an overall length of 166 metres, displacement of 7,000 tonnes, an overall beam of 21.5 metres and draught of 4.96 metres. To be powered by two diesel engines (driving two shafts) and two gas turbines, the TF-2000 ADW Destroyer will have a maximum speed of 28 kn, an economical speed of 18 kn and endurance of 5,000 nm at 18 kn. Under the TF-2000 ADW Destroyer Programme, which is expected to cost around US$4Bn, construction of the first ship will take place at Istanbul Naval Shipyard while the remaining three sister ships are planned to be constructed in private shipyards. The first ship's delivery was previously planned for 2027.

REIS Class Type 214TN Submarines

A total of six REIS class Type 214TN Air Independent Propulsion (AIP) submarines will be constructed at Gölcük Naval Shipyard. The construction of the first submarine TCG PIRI REIS (S-330) started in October 2015, the second one (TCG HIZIR REIS) started in 2016, and the third submarine, TCG MURAT REIS was officially started on 25 February 2018 with a 'first welding ceremony', while on 4 November 2018 the first welding ceremony for the fourth REIS class submarine TCG AYDIN REIS (S-333) was conducted. The construction of

Photo: MoND

The launching ceremony of the TCG PIRIREIS submarine at the floating dock

Photo: MoND

Submarine PIRIREIS leaves the floating dock.

Photo: via author

TCG ANADOLU LHD is being converted into a UAV and UCAV Carrier.

Photo: MoND

TCG SALIHREIS during a NATO naval exercise

the fifth submarine TCG SEYDI ALI REIS (S-334) started on 22 December 2019. TCG PIRI REIS was transferred to the dry dock for outfitting activities on 22 December 2019 and launched on 22 March 2021 at Gölcük Naval Shipyard. The submarine is expected to be commissioned by the TNF in 2022 following acceptance tests. The REIS class Type 214TN AIP submarines are planned to be commissioned between 2022 and 2027. The Type 214TN REIS class submarines are set to be the first AIP-equipped submarines operated by the TNF, and will replace four AY class (Type 209/1200) diesel/electric powered submarines.

MMU/TF-X: National Combat Aircraft

Turkey's next-gen National Combat Aircraft – MMU in Turkish, also known as TF-X – is a single-seat, twin-engine all-weather multi-role fighter developed by Turkish Aerospace (TUSAS) with technological assistance from BAE Systems. The MMU/TF-X will replace the F-4E 2020 PHANTOM and F-16C/D FIGHTING FALCON aircraft currently in service during the first quarter of the 2030s. Cost for the prototype is estimated at US$120M but each series production MMU/TF-X is targeted to cost US$80M.

Featuring Stealth and Supercruise capabilities and to be equipped with domestically developed systems and sensors, the MMU/TF-X will be a 5th generation indigenous air superiority fighter with secondary ground attack capability. The MMU/TF-X prototype will be in Block-0 (4+ Generation aircraft) configuration and is expected to be rolled-out in 2023 (planned for March 18, 2023), when Turkey will celebrate its 100th anniversary of the founding of the Republic. Following ground tests that are scheduled to start some time in 2024 and to last around two years, the maiden flight will be performed in December 2026. MMU/TF-X delivery to the TurAF will commence in 2029 and the first aircraft expected to enter TurAF service in 2029 will be in Block-I configuration. The TurAF is expected to declare Initial Operational Capability (IOC) with Block-I MMU/TF-X in 2031. According to the programme schedule TUSAS will start MMU/TF-X Block-II (in full 5th Generation fighter configuration) deliveries in 2031 and following their entrance into TurAF service, Full Operational Capability (FOC) will be declared by the end of 2032.

HURJET Advanced Jet Trainer (AJT) and Light Combat Aircraft (LCA)

The Critical Design Review (CDR) of the HURJET twin-seat, single-engine supersonic AJT and LCA was completed in March 2021. Speaking at a ceremony at TUSAS facilities on 25 February 2021, TUSAS CEO Temel Kotil disclosed that the HURJET prototype will perform its maiden flight in December 2022, after the completion of the design, prototype production and ground testing phases. HURJET is developed by TUSAS under a protocol signed between TUSAS, the SSB and the TurAF on 2 July 2018. The initial studies for the HURJET project were started in July 2017 and the project was launched in 2017 as a company funded project (which was funded from TUSAS' own resources) after receiving the green light to go ahead from the TUSAS Board.

ATAK Multi-Role Combat Helicopters

TUSAS manufactures the T129A/B helicopters under licence from Leonardo and as of 23 February 2021, the company has completed the delivery of 53

Photo: TUSAS

The first T129B Phase II ATAK helicopter at TAI's facilities

T129A/Bs (9A, 42B1 and 2 B2) to the Turkish Land Forces (TLF), 6 T129B1s to the Gendarmerie General Command and 1 T129B Phase-II (B2) to the Aviation Department of Security General Directorate (Turkish Police).

Valued at US$3.3Bn, the ATAK programme of the Turkish Land Forces Command (TLF) covers the procurement of nine T129A EDHs (Early Delivery Helicopters), 50 T129Bs (29 in Phase-I and 21 in Phase-II configurations +32 optional) tactical reconnaissance and attack helicopters. The T129B ATAK helicopters for the TLF have two basic configurations; Phase-I (B1, covering 29 helicopters) and Phase-II (B2, covering 21 helicopters). The T129B2 prototype performed its maiden flight at TUSAS facilities on 12 November 2019 and deliveries of the Phase-II T129Bs started on 15 February 2021. As of late February 2021 the T129 ATAK fleet has accumulated more than 30,000 flight hours.

Photo: TUSAS

T129B Phase-II ATAK Helicopter prototype seen here during qualification tests

In February 2019, the contract for the T129 Mk-II heavy attack helicopter was signed between TUSAS and SSB. The 10-tonne T129 Mk-II will be powered by two turboshaft engines and will have double the take-off weight of the T129A/B Mk-I ATAK multi-role light combat helicopter. The payload capacity will be more than 1,200 kg, and there will be three hard points on each wing and the armament will include a 30 mm, single-barrel automatic cannon attached to a turret under the helicopter's nose. The duration of the project is projected as 8.5 years. The Naval and Land Forces versions of Heavy Class

Photo: TUSAS

A T70 TUHP undergoing ground tests

Attack Helicopters are planned to be developed and at the end of development phase the three helicopter prototypes are planned to be delivered to the SSB along with the Technical Data Package. The TS3000 turboshaft engine with 3,000 hp propulsion capacity to be deployed on T129 Mk-II ATAK Helicopters is currently developed by TEI. TUSAS CEO Temel Kotil stated in March 2021 that the T129 Mk-II Heavy Class Attack Helicopter will have MTOW of 11 tonnes, a payload capacity of 1,500 kg and the prototype helicopter will perform its first flight with 2,500 hp class Ukrainian turboshaft engines on 18 March 2023. The Ukrainian engines will serve as a stop-gap solution until TEI will be able to deliver TS3000 engines for the project.

T70 TUHP

Valued at approximately US$3.5Bn, the Turkish Utility Helicopter Programme (TUHP) contract was signed on 21 February 2014 and became effective on 15 June 2016. Under the contract 109 T70 (S-70i International BLACK HAWK) helicopters (+191 options) will be manufactured with 63% local content over the next 10 years at TUSAS facilities. The Turkish Land Forces will receive 22 Utility/SAR configured T70s, the Special Forces will receive 11 T70s in the SAR/CSAR configuration, the Turkish Air Force will receive 6 in SAR/CSAR configuration, the Gendarmerie General Command will receive 30 in the SAR/CSAR/Armed Reconnaissance Helicopter (ARH)/UH configurations, the Security General Directorate (SGD, Turkish National Police) will receive 20 UH versions and the Directorate General of Forestry will receive 20 T70s in fire-fighting configuration. Ongoing qualification processes, including flight tests, will be completed in 2021 and deliveries are expected to start in 2022. TUSAS has previously declared its goal to deliver 36 T70s by the end of 2023.

Photo: TUSAS

TF-X mock-up in front of TUSAS`s new engineering building

T625 GOKBEY TLUH

The T625 GOKBEY Turkish Light Utility Helicopter (TLUH) programme will be executed under a US$687.3M contract awarded on 26 June 2013 by SSB to prime contractor TUSAS. Under the terms of the TLUH programme TUSAS has completed design, development and manufacture of an indigenous twin-engine 5-tonne class light utility helicopter with a take-off weight of 6 tonnes and powered by two CTS800-4AT turboshaft engines.

The T625 TLUH can accommodate a maximum of two crew, namely a pilot and co-pilot, and up to 12 passengers. The T625 TLUH prototype performed its first flight on 6 September 2018. The T625 GOKBEY TLUH will initially be certified by Turkish SHGM (Directorate General of Civil Aviation) and then converted with mission equipment for Turkish military use to replace the aging UH-1Hs and AB-205s. Certification and qualification efforts started in 2018. In December 2020, the TUSAS Board made a decision to start mass production of GOKBEY TLUH in 2021. The first confirmed customer of the helicopter was the Turkish Gendarmerie General Command (GGC), which placed an order for 20 GOKBEY TLUH to replace the aging 13 AB-205s in its inventory. TUSAS is currently manufacturing first batch of three GOKBEYs for the Turkish GGC. TUSAS President & CEO Temel KOTIL declared in a live TV programme that he attended on 14 March 2021 that the first delivery date of GOKBEY, which he previously announced as 29 October 2021, had been postponed to 2022. Within the scope of the project, the first T625 GOKBEY TLUHs will be delivered in mid-2022 and deliveries of the first batch of three T625 GOKBUY TLUHs will be completed by the end of 2022. Starting from 2023, TUSAS will be able to manufacture and deliver two T625 GOKBEYs per month. ■

The Return of Spetsnaz: Special Forces in the Donbas

Suman Sharma

To meet its objectives in the war in eastern Ukraine, the Russian military relies on the 'Gerasimov Doctrine' as a blueprint for conducting hybrid warfare.

NATO Secretary General Jens Stoltenberg in a statement in 2015 said: "Russia has used proxy soldiers, unmarked Special Forces, intimidation and propaganda, all to lay a thick fog of confusion; to obscure its true purpose in Ukraine; and to attempt deniability. So NATO must be ready to deal with every aspect of this new reality from wherever it comes. And that means we must look closely at how we prepare for; deter; and if necessary defend against hybrid warfare."

In what has now informally become famous as the 'Gerasimov Doctrine', the first mention of Russia's 'hybrid' warfare was made recently by the Russian Chief of the General Staff General Valery Gerasimov citing the Donbas region as the example where it was first used.

The Riga annual report (2015) of the NATO StratCom CoE (Centre of Excellence) lists the specific elements of this new type of warfare, as outlined by General Gerasimov:

- Military action is started by groups of troops during peacetime (war is never declared);
- Non-contact clashes between highly manoeuvrable, mixed specialty fighting groups;
- Elimination of the enemy's military and economic power by limited duration precise strikes on strategic military and civilian infrastructure;
- Massive use of high-precision weapons and special operations, robotics and weapons that use new physical principles (direct-energy weapons – lasers, shortwave radiation, etc.);
- Use of armed civilians (4 civilians to 1 military);
- Simultaneous strikes on the enemy's units and facilities throughout its territory;
- Simultaneous battles on land, air, sea, and in the information space.

Spetsnaz, the Russian special purpose forces, a term still used in erstwhile Russian speaking Soviet states, often draw comparison with the British 16th Air Assault Brigade and the American 75th Ranger Regiment, for their discipline and accurate marksmanship. An amorphous concept of small, specialised teams, trained to be air-dropped into enemy territory during WW II, these special units have been forged in the Red Army ever since.

Indian Navy retired Vice Admiral Pradeep Chauhan states that "Russian forces were already in Sevastopol according to an agreement with the Ukrainian government. That Russia used them to do what it did is true. However, one must remember that Crimea is 90% ethnic Russian and it always wanted to join Russia. It was a fluke of history that it ended up with Ukraine. As you can see, the situation of Crimea was unique. I don't think Russia uses special forces in any way different than other countries."

What followed the February-March 2014 Crimea annexation was the Donbas (short for Donetsk Basin) armed conflict, often referred to as the longest running offensive after WW II. Moscow used the 2008 Georgian conflict as a test ground for its new information warfare in South Ossetia and Abkhazia, and employed tactics like PsyOps, information warfare, covert ops, espionage, use of technology, cyber and electronic warfare in the Donbas in 2014.

The destabilisation of the 60,000-km² Donbas region in southeastern Ukraine, notable for its large coal reserves, was placed squarely on Moscow's irregular rebels, disinformation tactics, regular Russian armed forces and paramilitary groups. Moscow's initial denial theory was debunked after the sighting of the famous masked, 'little green men' in Sevastopol and the intervention by the Black Sea Fleet,

Operating within the paradigm of 'hybrid' warfare articulated by General Gerasimov, the Spetsnaz units engage in deep battlefield reconnaissance, surveillance, deep-seated sabotage missions, aiding regime changes, dissent, and training underground guerrillas.

In his 2013 article, General Gerasimov wrote that "The role of non-military means of achieving political and strategic goals has grown, supplemented by military means of a concealed character, including carrying out actions of informational conflict and the actions of special-operations forces."

Slavic Orthodox civilisation lies at the heart of the idea of retaking Ukraine and joining its borders with Russia with a vision to establish a Eurasian Union is said to dominate President Putin's aggressive foreign policy, thereby employing a strategy and tactics that blur the battle space from the physical to the virtual.

Aimed at protecting the Kremlin, the act of 'rigging' GPS signals is the brainchild of the Russian secret services and its special forces which 'lie about their actual position' via the GPS on the monitor on weapons' platforms or even phone devices which rely on satellite navigation systems. This interference sends incorrect signals and could even trigger the outbreak of armed conflict.

One may recall a similar phenomenon in the 1997 James Bond movie 'Tomorrow Never Dies', where a cyber terrorist was hired to trick a British naval frigate into straying into the South China Sea in order to provoke a war between China and the UK.

The Russian 1RL257 Krasukha-4 ground-based electronic warfare system is reported to have been deployed in Syrian war zones in the recent past, and as announced by Moscow in 2016, it had equipped over 250,000 cell towers with GPS phone-jamming devices.

Observers of the OSCE's (Organization for Security and Co-operation in Europe) Special Monitoring Mission (SMM) have complained in their daily reports about their surveillance drones in eastern Ukraine being subjected to "military-grade GPS jamming". This is reminiscent of the typical one-upmanship so common during the Cold War era, including when Moscow hid a giant jamming tower inside the tallest and oldest church of St Olaf's in the Estonian capital Tallinn to interfere with western TV and radio signals, something that eventually contributed to the collapse of the USSR.

Turkey's Combat Support Ship Programme

Kubilai Han

Increasing its Operational Capability, Replenishment At Sea Capability is a Significant Force Multiplier for the Turkish Naval Forces.

Since 2009, Turkey's support for counter-piracy operations off the coast of Somalia and in the Gulf of Aden under the framework of the United Nations Security Council (and the Grand National Assembly of Turkey, in addition to the deployment of the BARBAROS Turkish Naval Task Group in 2014, represent the first concrete signs that Turkish Naval Forces (TNF) intended to operate on the high seas. These deployments have also triggered the construction of new ships, submarines and missile projects aimed at building up the country's future naval forces.

The current Fleet Replenishment Ships, TCG AKAR (A-580) and TCG YARBAY KUDRET GUNGOR (A-595) which belong to the Turkish Logistic Support Ship Division based in Gölcük have been engaged in providing support to the Turkish Naval Task Group. This is a high seas formation created in 2010 to operate globally far from Turkish ports following Ankara's "Open Sea" policy. However, due to their low cruising speeds (13 kn), they were unable to keep pace with the frigates they were supporting, causing the Task Group to sail at slower speeds. Learning from this experience, the TNF requested that the next generation replenishment vessels, being constructed under the DIMDEG project, need to have a higher cruising speed.

Photo: TNFC

TNF SAS commandos landing at TCG AKAR during a naval drill

Replenishment at Sea and TNF's Logistical Support Ship Programmes

Given the realities of Turkey's geostrategic situation and the TNF's recent Open Sea strategy and priorities, a maritime support capability is essential. As a significant force multiplier, a replenishment at sea (RAS) capability extends the range and sustainment of both surface combatants and amphibious vessels.

RAS vessels provide for greater reach and endurance and allow self-reliant and sustained operations to be conducted away from the shore support base. This support capability, which enables warships to provide an ongoing presence and an immediate response to a developing situation, is vital for the TNF and Turkish Naval Task Group. Without such a maritime support ship to replenish fuel and other essential consumable stores, TNF surface units are restricted to operating at distances no greater than half their range. As proved by the Turkish Naval Task Group, with suitable replenishment ships and the ability to resupply at sea, surface combatants/units are able to remain at sea for weeks at a time. As a general indication, a surface combatant supported by a replenishment ship is limited only by crew rest considerations.

Although the acquisition of new surface combatants and amphibious ships is important, being able to support them as part of the TNF's capability to deploy locally, regionally and worldwide, is also vital. In this context, along with the surface combatants, the TNF launched projects to renew its logistics assets. The TNF intends to expand its logistics fleet by 2025 with the induction of a locally constructed 22,000-tonne Replenishment At Sea and Combat Support Ship (DIMDEG) TCG DERYA, two medium-sized Logistic Support Ships and two new (with two more optional) Replenishment Tankers. These new logistic support ships will assist the existing fleet which is currently comprised of TCG AKAR (which entered service in September 1987) and TCG YARBAY KUDRET GUNGOR (in service since October 1995, the first ever ship built for the Turkish Navy by a private Turkish shipyard). In addition, the fleet is supported by TCG ALBAY HAKKIBURAK (A-571) and TCG YUZBASI I. TOLUNAY (A572) Liquid Fuel Tankers.

Author

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TCG DERYA Replenishment at Sea and Combat Support Ship (DIMDEG)

In order to meet the Turkish Naval Forces Command's new generation Fleet Replenishment Ship requirement, the DIMDEG project was launched in order to satisfy the fuel, water, and supply needs of surface units operating on the open seas around the world.

The DIMDEG contract was signed between SSB and Istanbul-based private shipyard Sefine Shipyard on 28 June 2018. On 25 January 2019, Sefine Shipyard signed a contract with Aselsan-Havelsan Business Partnership for the procurement and integration of combat systems (including Havelsan's ADVENT Combat Management System [CMS], Ship Data Distribution System, Ship Information System and Message Operating System, as well as Aselsan's MAR-D Surveillance Radar, 25 mm STOP Stabilised Naval Gun System, IFF System, Integrated Communication System, KIRLANGIÇ EO/IR Reconnaissance and Surveillance System, SatCom System, and 2x GÖKDENİZ CIWS) to the DIMDEG.

TCG DERYA will be a multi-purpose replenishment ship (AOR) which effectively combines the functions of a fleet oiler and store ship. The platform will be used for replenishment at sea of fuel, water, food, spare parts, medical supplies, and ammunition. The vessel will have an overall length of 194.8 metres, a height of 7.2 metres, displacement of 22,000 tonnes and a beam of 24.4 metres. To be powered by two gas turbines,(in June 2020, GE Marine received a contract from Sefine Shipyard to provide two LM2500 marine gas turbines for DIMDEG and two diesel engines. TCG DERYA will have a maximum speed of 24 kn, an endurance of 30 days (minimum) and a maximum range of 4,500 NM. The ship will also have a large helipad and dual enclosed hangar facilities to embark two multi-purpose helicopters up to 15 tonnes. It will also be capable of serving as a command and control ship. The DERYA is scheduled to enter service in 2024.

Photo: TNFC

A-595 YARBAY KUDRET GUNGOR and Italian FREMM class frigate ITS CARABINIERE (F-593) conducting a joint patrol in the Mediterranean

Photo: SSB

On 28 June 2018, SSB and Istanbul-based private shipyard Sefine Shipyard signed the DIMDEG contract.

Logistic Support Ship Project

Covering the acquisition of two oil tankers from a local shipyard, the Logistic Support Ship Project began in July 2012. The ships will provide combat support in terms of logistic support to meet the liquid fuel (F-76 and JP-5), fresh water and food requirements of the surface combatants, both at sea and ashore. Logistic Support Ships with their onboard capabilities can also support humanitarian aid and peace operations.

Istanbul-based private shipyard Selah Shipyard was selected in May 2014 and the contract was awarded on 4 November 2014, with an advance payment by the SSB taking place on 24 November 2014. According to the contract, the Logistic Support Ships were scheduled for commission in 2018. Construction of the first Logistic Support Ship TCG YUZBASI GUNGOR DURMUS (A-574) started in 2015 and the ship was launched on 8 October 2016 at Selah Shipyard. The second ship of the project, TCG USTEGMEN ARIF EKMEKCI (A-575) was launched on 8 July 2017.

A computer-generated model of the DIMDEG ship

Photo: Yoruk Isik

The Turkish Navy GUNGOR fleet replenishment ship (A-595)

In 2019, Selah Shipyard declared illiquidity due to the economic crisis and was unable to fulfil its commitments under the contract, meaning that during the second half of 2019, the SSB terminated the contract signed with Selah Shipyard under the Logistic Support Ship Project. SSB then selected STM for the completion and delivery of the Logistic Support Vessels. According to the current schedule, TCG YUZBASI GUNGOR DURMUS will be delivered in 2021 and TCG USTEGMEN ARIF EKMEKCI will be delivered in 2022.

With a displacement of 8,744 tonnes at full load, the 105.44-metre Logistic Support Ships' maximum speed will be more than 12 kn and they could reach a range of 9,500 NM at full load displacement, at sea state 2. The vessels have a capacity of 4,036 tonnes of F-76 diesel fuel, 336 tonnes of helicopter fuel (F-44/JP-5) and 594 tonnes of freshwater and at least 108m3 of food/meals. The ships also have a large helicopter deck that allows take-off and landing and can refuel helicopters. The helipad also allows for day and night-time helicopter take-off and landing and is designed to support multi-purpose helicopters up to 15 tonnes. The ship is also equipped with a hydraulic crane with a lifting capacity of 18 tonnes and an electrical crane, with a lifting capacity of 2 tonnes.

Replenishment Tankers for the FACs

Under the Replenishment Tankers Procurement Project, on 9 December 2020, SSB issued a Request for Proposals (RFP) document to local shipyards for the procurement of two new (plus two optional) Replenishment Tankers along with spare parts, training service and related documents. According to the RPF document, bidders should submit their proposals by 15 March 2021. According to the RFP, the main mission of these ships is to meet the liquid fuel requirements of the Fast Attack Craft (FACs) in a safe and rapid manner in a possible naval operation and/or war, while they are in a waiting/hiding place. The Turkish Navy's two ALBAY HAKKI BURAK class liquid fuel tankers are currently providing fuel support capability for the FACs. Speaking at a Defence & Technology Days event organised by ITU SAVTEK on 24 March 2021, Alper Kose, Head of the SSB Naval Platforms Department, disclosed that SSB will soon launch a tender for the procurement of the Replenishment Tankers Procurement Project. ■

Photo: TNFC

The Turkish Navy TCG AKAR (A-580) performs Replenishment at Sea to the GABYA class frigate GIRESUN

Deployment of Special Forces Equipment or Resupply by Air

André Forkert

Aerial delivery systems become an increasingly important tool in Special Forces and Anti-Piracy operations.

Picture yourself: a member of a dismounted long-range patrol operating in extremely difficult terrain and your location cannot be reached by ground transportation, and no airfields or landing strips can be found nearby. What's more, your last resupply was four days ago. You are eagerly awaiting an airdrop of much-needed supplies at a very small clearing near your position so you can continue your mission. This is a scenario which often plays out during long-range special operation missions, or even for the Navy Special Forces or submarines on operations in the middle of nowhere. Sometimes though, it is not only an issue of resupply with aerial delivery systems becoming an increasingly important tool in Special Forces and Anti-Piracy operations. One of the latest known examples is the hijacking of the MAERSK ALABAMA and its captain Richard Phillips on 8 April 2008 by Somali pirates in the Indian Ocean.

The United States Naval Special Warfare Development Group (DEVGRU) flew in directly from the US in a Boeing C-17 GLOBEMASTER. After a 20-hour flight, the Navy SEALS conducted a HAHO (High Altitude, High Opening) jump with all their personnel and equipment - not only weapons and boarding equipment, but also High-Speed Assault Craft (HSAC). This was the only way to reach the hijacked ship before it entered Somali coastal waters. Only aerial delivery can give you the advantage of speed, without being seen or heard by the enemy and also risking aerial assets such as airplanes and helicopters. Thanks to the HAHO operation, the team was able to glide through the air for many miles.

Author

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Photo: US Army

Soldiers receive supplies by airdrop.

Low-Cost, Low-Altitude Aerial Resupply

There are several procedures, which can be employed for this type of operation. The simplest version is the so-called "Africa procedure", which was developed by the German Luftwaffe in 1985 during operations in Ethiopia. In this procedure, goods are dropped from the lowest altitude - practically at zero altitude - and without cargo parachutes via the tail ramp. Back then, it was carried out by the C-160 TRANSALL and Lockheed Martin C-130 HERCULES. Even the Airbus A400M was certified for this procedure shortly after its introduction. However, it is mainly used for humanitarian aid missions.

In 2008, the US Army started a project to develop a low-cost, low-altitude (LCLA) aerial resupply. As the acronym "LCLA" indicates, the project focused specifically on developing low-cost parachutes for airdropping supplies at altitudes from 500 feet down to 150 feet above ground level (AGL). Such parachutes can support forces that are operating:

- Substantial distances from forward operating bases (FOBs).
- In remote, challenging locations hard to reach by ground transportation.
- With limited or no MHE to conduct recovery or retrograde operations.
- In locations with no usable airfields or airstrips to conduct air-land operations.

LCLA is one of several key integrated logistics aerial resupply delivery systems that the Army and joint communities are developing in synchronisation with surface distribution operations to provide the combatant commander with the aerial resupply capabilities and enablers needed to meet the requirements of full-spectrum operations.

The primary objective of the LCLA capability is to improve tactical logistics support by enabling rapid and precise delivery and distribution of small, tailored support packages of configured loads to small units, with no operational pauses and with a much smaller logistics footprint. Low-cost, one-time use parachutes were used. Depending on the weight of the supply, new systems and also older T-10 and T-10 reserves were used. The resupply systems weighed between 30

Photo: SGT David Reardon, 1st Sustainment Brigade PAO

Parachute riggers load pallets into a C–17 aircraft. Container delivery systems help to make this process easier and faster.

and 350 lbs with the average cost per parachute system being US$125.

Container Delivery Systems

All modern tactical or strategic aircraft and helicopters offer a Container Delivery System (CDS). The CDS can help to deliver material directly and quickly. CDS helps the crew to load or unload material in containers or on pallets quickly at airports or with the help of tactical cranes and winches at all kinds of improved and temporary airstrips. One system is the remote controlled, 4x4 Palfinger CRAYLER. This small, all-terrain, foldable, and air-transportable vehicle can carry up to 1,400 kg with its forklift. On the other side, nearly all A400M aircraft in Europe will be fitted with the Crane Mobile Equipment (CME), developed by Spanish company Héroux-Devtek. This crane is attached to the ceiling above the rear ramp and can lift up to 5 tonnes. The system is designed to simply put the load onto the ramp and the CDS or just outside in front of the ramp.

But the CDS also makes it easier to drop the cargo directly over the target from an aircraft. For example, the German Luftwaffe certified their Airbus A400M for this kind of delivery. From altitudes of 200 to 300 metres and at an airspeed of 240 km/h, pallets are dropped from the cargo hold via the tail ramp, which, suspended from one or more cargo parachutes, land in the predetermined target area. With the C-160 TRANSALL, this initially required an auxiliary parachute to pull the load out of the cargo hold. With the A400M, this is no longer the case due to the modern cargo hold. During the A400M procedure, the load is unlocked above the calculated drop point by the technical loadmasters. Due to the aircraft's flight inclination (nose slightly raised), the load leaves the aircraft by gravity via rollers attached to the cargo hold floor. In the process, the parachute package (auxiliary parachute and load parachute(s)) are released via a connecting line (static line) attached in the hold and floats to the ground.

Intensive preparation is necessary to ensure that everything goes according to plan. Good communication among the crew, i.e. between the technical loadmasters and pilots, is required during the airdrop. In addition, constant radio contact is maintained with a Combat Control Team (CCT) in the landing zone so that the pilots receive all the necessary data, such as wind speeds.

The CDS is used in these procedures and is currently the most common method for airdropping loads. It is a "low cost" procedure with the container built with relatively simple means, such as plywood boards. One or more cargo parachutes are attached to the container. An A400M can drop up to 24 CDS loads at once - each containing one tonne of supplies. Available systems, e.g. from Leonardo DRS, include restraint rails, roller trays, tie-down points, electronic or mechanical palletized cargo locks for tactical airdrop or transport restraint, parachute release mechanisms, tow-plate, mechanical or electronic system controls and structural floor panels if required. With the Leonardo CDS, even older airplanes can be upgraded.

Photo: Bundeswehr

The Airbus PARALANDER is a fully autonomous GPS guided cargo delivery system. It can carry up to 1,000 kg.

Boat Delivery Systems

As mentioned above, the Navy SEALS use High Speed Assault Craft for their anti-piracy missions. These boats are dropped from an airplane by parachute to the ocean. The boat crew and the SEALS follow the boats by parachute.

There are two major differences here: one system delivers a packed, often rolled up boat by cargo chute and the engine often by a second chute. The Special Forces have to assemble the boat in the water after landing to ready it for use. This needs more time and can be a no-go in heavy weather and a challenging sea state.

Other systems use a fixed platform - similar to a ladder frame - on which the mounted boat is ready for use. This load includes the frame and the parachute and is then trans-

ferred to the rear cargo bay of a transport aircraft. After landing the boat with this system, the separately deployed Special Forces team only have to get on board and can immediately initiate the mission. With such a system, rigid inflatable boats (RHIBs) as well as other rigid hull boats can be used. The parachute and frame are simply left to sink in the sea. For training missions, the frame is used with buoyancy devices for cost-effective re-use.

In the case of helicopters, a cargo harness without a parachute is often used for transport. The boats are then lowered directly into the water by the helicopter. Because of the size and weight of the boat, helicopters used include the Boeing CH-47 CHINOOK or Sikorsky CH-53K.

The British Special Boat Service (SBS), as well as the US Navy SEALS have been using such systems for some time. In English, these missions are called "boat drop" or "boat airdrop" operations. In the UK, the Royal Air Force (RAF) provides compatible cargo drop systems for the RAF 47 Squadron C-130J HERCULES, C-17A GLOBEMASTER and A400M ATLAS aircraft types. According to the UK Armed Forces, the UK is the world leader in this field of "boat dropping". Systems developed by British companies are in use by special maritime units around the world. The most common system in the western world is the Maritime Craft Aerial Delivery System (MCADS). This was developed by Airborne Systems (now part of the US company IrvinGQ). MCADS operators include armed forces from the UK, US, Australia, France and Norway.

Photo: Bundeswehr

The Palfinger CRAYLER can be carried in or underneath a helicopter. It helps to move supplies from or into an aircraft or carry it from the ramp to the place needed.

MCADS uses the PRIBAD 21 (Platform, Rigid Inflatable Boat Aerial Delivery 21 ft) platform, which can accommodate boats from 9 to 12 metres in length, and PURIB-AD (Platform Universal, Rigid Inflatable Boat Aerial Delivery), for boats from 6.5 to 8.5 metres in overall length. According to the company's promotional material, it is the only system in operation that can also drop "large" RHIBs. In 2011, the first versions of the MCADS were delivered to the UK Ministry of Defence, which are configured to drop boats of 6.5 m to 8.5 m in length from UK C-130J aircraft.

Another boat drop system in UK service is the Small Boat Aerial Delivery System (SBADS), developed by Babcock International's Marine & Technology Division. SBADS is used for boats over 3.6 metres in length. The UK Ministry of Defence reportedly ordered 186 SBADS units in 2011.

France also uses similar systems. In 2011, France signed a contract with Zodiac International for the delivery of Multi-Purpose Commando Boat (ECUME) systems. Part of the contract was the MCADS. Officially, four systems in the PRIBAD 21 version were procured at that time, and delivery began in 2013. At the same time, Norway ordered the MCADS PRIBAD 21 for 11-metre boats, the con-

Photo: Bundeswehr

A packed resupply palette with the PARALANDER system attached on top in front of a German C-160 TRANSALL.

Photo: Palfinger

The Palfinger CRAYLER can move material up to 1,400 kg in all kinds of conditions.

Photo: USAF

The Maritime Craft Aerial Delivery System (MCADS) deploys via the ramp to fly to its target destination. Immediately after, the boat crew and US Navy SEALS will follow.

Photo: US Air Force photo/Staff Sgt. Mike Meares

A 535th Airlift Squadron loadmaster ensures the settings on the C-17 GLOBEMASTER III are correct in preparation for an airdrop mission with a US Navy Maritime Craft Aerial Delivery System.

tract volume at that time was 2.8M British Pounds. As early as 2010, the South African Special Forces ordered the system for their new Zodiac 7.5-metre RHIBs. And Germany released a tender in October 2020 for 16 "boat delivery systems" for their Special Forces. It is unclear which systems won the contract.
There are many drop systems without a frame mount on the market, for example, systems from the German manufacturers Autoflug GmbH, Sächsische Spezialkonfektion GmbH (SPEKON) or PARATEC GmbH or Brüggemann GmbH & Co. KG. They can also supply the parachutes or load harnesses.

Unmanned Ground Vehicles

However, it is not only boats that have to be delivered to remote places for Special Forces and light infantry troops. There is also the need for manned and unmanned ground vehicles (UGV). Manned vehicles are somewhat easier, as the driver can start them, but unmanned reconnaissance or supply ground vehicles are often flown in without personnel following behind. The UGV must be able to free itself from the system after landing and begin its mission.
Again, IrvinGQ has developed an airborne platform for dropping the UGV THeMIS from Milrem Robotics. A UGV also enables operations in high-threat areas without exposing soldiers to direct danger. However, the UGVs are not only supposed to be safer, but also be more effective or powerful than comparable manned systems. Thanks to the cargo parachute system developed by IrvinGQ, the UGVs can be quickly deployed – on operations or to forest fire areas. The ATAX Land airdrop system, which IrvinGQ has adapted for the Milrem Robotics THeMIS UGV and the Multiscope Rescue UGV is used for this purpose.
ATAX is a modular rapid rig/de-rig parachute system that uses soft landing airbags instead of traditional energy dissipating materials (EDM). The reusable airbags reduce load preparation and packing times by eliminating unnecessary rigging materials. In addition, the impact forces acting on the load are significantly reduced. This gives the vehicle a true drive-on drive-off capability. After landing, the UGV is automatically released and is able to drive without soldiers having to do anything first. The manufacturer promises a fully autonomous capability. In addition to the parachute system (for example G11, G12, SC15 and comparable), the overall system consists

of a lightweight platform on which the vehicle is lashed. The platform measures 2.74 x 2.46 m and can be dropped from aircraft such as the C-130 HERCULES, C-17, Embraer KC390 or Airbus A400M. The knowledge and technicalities of this system can also be transferred to other UGV systems.

Precise Resupply from the Air

Normal airdrops are not always precise enough, something which can mean Special Forces troops are forced to leave their covert observation posts to collect the resupply. Therefore, the parachute should land within only a few feet from their position, and at night. Or it could be that the plateau on which the snipers are hidden is very small and 25 metres would mean missing the target and losing the supplies.

Therefore, several forces are using a fully autonomous GPS guided cargo delivery system. Germany is still developing the so-called Selbststeuernde Lastengleitschirmsysteme (SLG Sys). This one is based on the Airbus ParaLander L1000 system that can carry 1,000 kg. In addition to the SLG Sys 1,000 kg, Airbus has developed a 300 kg system and tested it together with the Bundeswehr. According to the manufacturer, there are plans for 3,000 kg and 5,000 kg systems. Currently, however, smaller systems with less payload in the 400 kg and 250 kg ranges are more in demand. The DEU Rapid Forces Division has already written an initiative for 250 kg, but it has since been suspended. The new system is to be called ALAG Sys (Autonomous Load Gliding System). An initiative for a 350 kg system is currently being prepared, and the Kommando Spezialkräfte (KSK) is also interested in this weight class. The new system should also be equipped with a "Follow Me" mode.

Other nations, for example, the Netherlands, have had systems in use for years, which have been dropped in operations including in Afghanistan. The DragonFly family from Airborne Systems is in use by the US, the Netherlands and Great Britain. The Airborne Systems family includes the Unicross 150/500/2200, Flycops (300-999 kg payload), MicroFly II (10-mile range) and FireFly (1,000 kg payload, 25 km range), MegaFly and the GigaFly systems with up to 20,000 kg are in development. DragonFly can bring supplies from 2,222 kg to 4,536 kg. The system lands within 250 metres of the designated Impact Point (IP). The German system should be more precise. ■

Photo: U Air Force photo/Staff Sgt. Mike Meares

Air dropping a boat: The Navy Special Warfare Unit ONE Maritime Craft Aerial Delivery System deploys from the ramp of a C-17 GLOBEMASTER III during airdrop operations in Guam.

Photo: US Army

The US Army conducts operational testing with a new parachute with the A-24 container delivery system here.

Graphic: IrvinGQ

Milrem Robotics, in cooperation with IrvinGQ, is capable of deploying its UGV and an autonomous strike capability by parachute using the ATAX airdrop system.

UUVs Revolutionise Mine Hunting and Neutralisation

Luca Peruzzi

The threat posed by advanced and smart naval mines and waterborne improvised explosive devices (WBIED) has triggered the development of new families of small and medium unmanned underwater vehicles (UUVs) in both autonomous (AUV) and remotely operated (ROV) configurations.

While these vehicles and their compact sensor payloads have found applications among commercial, scientific and academic communities, it was not until more recently, when associated technologies matured through targeted investment in military-specific enablers, that UUVs have been procured by navies worldwide.

Photo: US Navy Chief Petty Officer Travis Simmons

The US Mk 18 family of small and medium AUVs, based on the Hydroid REMUS 100 and 600 vehicles, continue to be upgraded.

United States and Canada

The US Navy's families of small and medium AUVs, respectively defined as having 7.62 - 25.4 cm and 25.4 - 53.3 cm diameters, are the most widely used systems, employed by the Navy's frontline units, Explosive Ordnance Disposal (EOD),Special Warfare units, Submarine UUV Squadron (UUVRON), Naval Oceanographic Community (NMOC), United States Marine Corps and homeland defence operators. The US Mk 18 Mod 1 (SWORDFISH) and Mod 2 (KINGFISH) families of small/medium systems are based mainly on the Hydroid REMUS 100 and 600 and L3Harris IVER3 and 4 UUVs. The General Dynamics Mission Systems BLUEFIN 9 and 12 and Hydroid RAZORBACK vehicles are also widely deployed among navies and homeland agencies globally, used for a wide range of missions, including bottom mapping/survey, mine warfare, Intelligence Preparation of the Operational Environment (IPOE), rapid object localisation and Intelligence, Reconnaissance and Surveillance (ISR). Teledyne Technologies was awarded 'the first significant order by the Naval Sea Systems Command (NAVSEA) to supply self-propelled AUVs in 2019.

The Mk 18 family of systems (FoS) is continuously being enhanced. The Mk 18 Mod 2 INCREMENT II upgrade will provide improved Automated Target Recognition (ATR) algorithms, more advanced autonomy architecture and continue electro-optic sensor performance enhancements. The Mk 18 Mod 1 is undergoing a configuration change including a higher area coverage rate and ATR. Integration plans for Mk 18 FoS aboard larger platforms other than the current 11-metre Rigid Hull Inflatable Boats (RHIBs) are ongoing.

The KNIFEFISH

As part of the MCM Mission Package for the Littoral Combat Ship (LCS), the US Navy has also introduced the KNIFEFISH Surface Mine Countermeasures UUV (SMCM UUV) medium class system based on the 53.3 cm diameter General Dynamics BLUEFIN 21, to support clandestine mine detection capability against volume, bottom and buried mines. Having achieved initial operational capability in 2019, the KNIFEFISH is also being integrated on FREEDOM class LCS vessels, in addition to the INDEPENDENCE class LCS variant. Planned Block Upgrade candidates under consideration include increased detection range capability, communications upgrades, onboard sonar processing and target recognition, command and control improvements, increased operational depth and potential future payloads.

The RAZORBACK AUV

he US Navy has also developed the Littoral Battlespace Sensing-Autonomous Undersea Vehicle Submarine Variant (LBS-AUV(S)) known as the RAZORBACK AUV, which will deploy from submarines for persistent, autonomous, ocean sensing and data collection in support of IPOE missions. Both the RAZORBACK and baseline Mk18 Mod 2 platforms are based on the Hydroid REMUS 600 vehicle capable of reaching a depth of 600 m. With a variable diameter and length of up to 32.4 cm and 5.5 m respectively in the 600 m depth configuration, the REMUS 600 has a typical mission endurance of up to 24

hours in standard configuration. The highly reconfigurable vehicle can accommodate a range of sensors, including dual frequency side scan sonars, Kongsberg HiSAS 2040 Synthetic Aperture Sonar (SAS) with a 2 cm x 2 cm resolution across a 300-m swath, and a Kraken Robotics AquaPix MINSAS (Miniature Interferometric Synthetic Aperture Sonar). This is in addition to a video camera and navigation suite to include DVL (Doppler Velocity Log), Compass or Inertial Navigation and GPS/Wi-Fi/Iridium. The RAZORBACK can be deployed from host submarines in two variants: from the Dry Dock Shelter (DDS) or from the torpedo tube. Already undergoing testing by the UUVRO N, the first seven operational RAZORBACK AUVs in the DDS version are expected to be delivered this year with fleet operational deployment to be conducted later in FY 2021. The torpedo-launched capability is being procured within the new common Medium UUV programme that will support both the submarine and the EOD communities.

The US Navy is currently working on new families of small and medium-sized UUVs. Due to be launched in FY 2021, with production deliveries in FY 2023, the multi-mission small UUV (SUUV) programme, utilising advances in commercial technologies, will provide a baseline lightweight, highly portable and mission configurable small UUV for different user communities. In January 2019, the US Defense Innovation Unit (DIU) awarded an Other Transaction Agreement (OTA) contract to L3Harris Technologies for the Next Generation Small-Class Maritime Expeditionary Mine Countermeasures Unmanned Undersea Vehicle (MEMUUV) programme. This award includes the delivery and testing of an IVER4 - 900 UUV and two field swappable modular payload sections, sensors, batteries and ancillaries to develop a highly capable UUV that can detect, classify, localie and identify targets in the water column and seabed in support of Expeditionary MCM, EOD, and undersea search operations. In June 2020, L3Harris unveiled a 14.7 cm large and 2.08-m long version of the IVER4 family called IVER4 580, capable of reaching a depth of 200 m and featuring a full suite of sensors.

Photo: US Navy Petty Officer 1st Class Brian Brooks

As part of the LCS MCM mission package, the US Navy introduced the KNIFEFISH Surface Mine Countermeasures UUV (SMCM UUV) based on the 53.3 cm diameter General Dynamics BLUEFIN 21 vehicle.

The REMUS

In February 2020, Hydroid announced the delivery of the first prototype REMUS 300 to the US Navy through the DIU. Assessed as a potential candidate for the Navy's next generation SUUV programme, the commercially derived and upgraded REMUS 300 conforms to the Navy's newest Modular Open System Architecture (MOSA) and Unmanned Maritime Autonomy Architecture (UMAA) standards for rapid technologies and systems integration. Based on the same 19.05 cm-diameter as Hydroid's proven and worldwide used REMUS 100 AUV, the REMUS 300 has an increased depth rating of 305 m, and remains two-man portable. Weighing 36 - 60 kg and 1.85 - 2.51 m in length depending on field changeable, environmentally sealed energy modules, providing 12 - 29 hours endurance on lithium-ion batteries, the REMUS 300 can be equipped with a sensor suite including a single or dual frequency side scan sonar.

In the small to medium UUV/AUV segment, Teledyne Technologies is also globally promoting its family of Teledyne GAVIA vehicles (the Polish Navy being the most recent customer), the SeaRaptor 3000 or 6000 m capable AUVs and Teledyne Webb Research SLOCUM gliders.

In May 2020, NAVSEA released a request for proposals for the award of multiple contracts with the scope of designing, developing, and producing a new Medium Unmanned Underwater Vehicle (MUUV). Intended to support both the RAZORBACK and MEMUUV system programmes, the next generation MUUV will be modular with a common baseline vehicle architecture, including sensors and components, for both the submarine and expeditionary configurations and dedicated launch-and-recovery systems. Building on lessons learned and submarine integration from previous science and technology efforts, the RAZORBACK Torpedo Tube Launch & Recovery (TTL&R) configuration contract was to be awarded in the 1Q FY 2021 with design, fabrication and testing lasting until 1Q FY 2024, concurrently with submarine integration between 4Q FY 2022 and 1Q FY 2024.

Photo: L3Harris

The L3Harris company has been contracted under the Next Generation Small-Class Maritime Expeditionary Mine Countermeasures Unmanned Undersea Vehicle (MEMUUV) programme for the delivery and testing of the IVER4 - 900 UUV.

Photo: Hydroid

In 2020, Hydroid announced the delivery of the first prototype REMUS 300 to the US Navy as a potential candidate for the Navy's next generation SUUV programme.

Photo: ECA Group

The ECA Group is providing the new generation A18-M AUV, together with its UMISAS interferometric synthetic aperture sonar, to fulfil the requirements of the Belgian and The Netherlands navies' requirements.

Using high energy density sources such as lithium-ion batteries to provide sufficient endurance, safety is paramount for the US Navy. Launched in 1Q FY 2020 with development, integration and testing lasting until 4Q FY 2024, the Shock and Fire Enclosure Capsule (SAFECAP) programme includes a shock-qualified capsule that assists in the launch and recovery of small/medium sized vehicles through the torpedo tube, and a battery casualty detection system that constantly monitors battery health and status. In the event of a battery casualty, the capsule and vehicle portion of SAFECAP are flooded via the fire hose connections and the event is extinguished.
Among the sonar payload developers in Northern America, the Canadian Kraken Robotics company announced in March 2020 that it had achieved a practical resolution of 2 cm with its AquaPix MINSAS Commercial-Off-The Shelf (COTS) Synthetic Aperture Sonar. Kraken's Ultra HD software improves the AquaPix SAS image resolution from 3.0 cm x 3.3 cm (across along track) to an industry-leading 1.9 cm x 2.1 cm and maintains a constant Ultra HD resolution across the entire swath. The MINSAS and Ultra HD software combination will significantly enhance the surveillance and mine detection operational tempo while enlarging the range of AUVs capable of accommodating the Kraken Robotics suite.
In July 2020, the US Office of Naval Research (ONR) released a broad agency announcement (BAA) showing interest in advanced technologies for low-observable/no-collateral damage neutralisation of underwater mines and WBIEDs. "The ONR seeks to develop and demonstrate advanced payloads that enable EXMCM forces to neutralise underwater mines and WBIEDs without causing them to function as designed, which would give away the element of surprise, or cause damage to underwater infrastructure." A diver or Remotely Operated Vehicle (ROV) will deliver these payloads. The technologies developed "will transition to the existing Explosive Ordnance Disposal (EOD) Maritime Expeditionary Standoff Response (MESR) programme, which will field underwater capabilities required to counter naval mines, WBIEDs and other unexploded explosive ordnance (UXO) threats in the undersea and littoral marine environments." Industries interested were due to submit their full proposals by last November with selection and contract awards due in the first quarter of 2021.

Europe

The Old Continent's underwater industry has developed a range of UUV/AUVs and surveillance payloads to satisfy both military, national security, and export requirements. The French ECA Group is offering a complete family of vehicles for surveillance as well as MCM missions, including the smaller A9-M, medium A18-M and large A27-M AUVs, in addition to the SEASCAN Mk2 self-propelled ROV and K-STER C expandable mine disposal system. These vehicles are managed through the new generation ECA-designed UMISOFT MCM C2 software suite, and together with the same company's INSPECTOR 125 USVs and T18-M towed sonar, form part of the ECA Group UMIS drone-based suite for MCM operations. A man-portable AUV, 2 m in length, 23 cm in diameter and weighing 70 kg, the low signature A9-M can reach a depth of 300 m and has a maximum speed of 5 kt. It is equipped with a navigation suite with INS, DVS, depth sensor and GPS, alongside a mission payload including a dual (455/900 kHz) simultaneous frequency sonar, or alternatively an interferometric side scan sonar and camera. The new generation medium-size A18-M is easily deployable from MCMVs, non-dedicated platforms and USVs, while still packing a large payload capacity. With a variable length from 3.8 m, 46.5 cm in diameter and weighing more than 370 kg, the A18-M has an endurance of up to 24 hours at a speed of 3 kt. Capable of reaching a depth of 300 m, the AUV has a very accurate and high coverage rate thanks to its navigation suite, which includes INS, DVL and GPS and the UMISAS interferometric synthetic aperture sonar (InSAS) made by the same company. Developed with the medium-sized A18-M in mind, the UMISAS has a reduced weight, size and consumption, and aims to obtain a spatial resolution of about 3cm x 3 cm, constant with range, together with high area cov-

erage rates (i.e. one square NM per hour for the UMISAS 240 model fitted to the T-18M towed body sonar). The ECA Group developed a new technique, protected by patent, which allows for InSAS images geo-referencing, improved positioning of the AUV and, above all, increased reliability, the company claims. The UMISAS was successfully sea trialed in the second half of 2020 in preparation for integration on both the A18-M and the T-18M towed body sonar as part of the robotics MCM (rMCM) programme for the Belgian and Dutch Navies. This programme includes a toolbox of AUVs, ROVs, USVs and UAVs, in addition to 12 mother ships provided by Belgium Naval & Robotics, the consortium of Naval Group and ECA Group. The French company also developed the larger A27-M multimission, long endurance AUV, 4.5 m - 5 m in length, 73 cm in diameter and weighing 900 – 1,100 kg. With an endurance of up to 45 hours and a maximum depth of 300 m and a multiple-payload suite, the A27-M is part of the French/UK Maritime Mine Counter-Measures (MMCM) programme. All ECA UAVs can be equipped with the so-called Automatic Target Recognition (ATR) software tool that allows it to generate mine-like contacts (MILEC) while performing its sea floor reconnaissance mission, significantly reducing the timeline for MCM missions.

The SEASCAN

The SEASCAN Mk2 is a man-deployable, lightweight re-usable self-propelled ROV for inspection and identification purposes only. Powered by a rechargeable battery providing up to 3 hours of endurance, the 1.58 m-long and 50 kg-heavy SEASCAN Mk2 benefits from the real time sensor data gathering through the optical fibre without the limitations of umbilical equipped ROVs. With a 300 m maximum depth, this ROV is fitted with a relocation sonar for target reacquisition and a tiltable camera for inspection and formal identification. The K-STER C is a lightweight expandable mine disposal vehicle capable of being used by MCMVs and is automatically deployed from USV platforms. It is 1.5 m in length, weighs 50 kg, and has a patented tilting head (+90° to -90°) containing an insensitive explosive shaped charge. Its battery power supply allows it to be used in high currents (up to 4 kt) and to neutralise all types of mines, from bottom, including partially buried, to floating and the smartest mine threats.

With over 300 mine-hunting systems in service worldwide, Thales group reached a new milestone with its SAMDIS high-frequency, single-path multi-view synthetic aperture sonar programme. With its expertise in sonar processing well known, in late March, under a joint French - Japanese Defence agency cooperation agreement, the French Group joined forces with Mitsubishi Heavy Industries (MHI) to develop a Dual Frequency sonar demonstrator for a AUV to be evaluated at sea, both in Japanese and French waters. Under a five-year project, Thales will provide its SAMDIS sonar with multi-aspect capability, while MHI will supply its low frequency synthetic aperture sonar and OZZ-5 AUV.

Photo: Thales

Thales and Mitsubishi Heavy Industries groups have signed a cooperation agreement to develop a dual frequency sonar demonstrator for a AUV to be evaluated onboard the OZZ-5 vehicle in French and Japanese waters.

Photo: NATO MARCOM

The German Atlas Elektronik has developed one the most-sold expandable mine disposal system (EMDS) based on the SEAFOX vehicle.

The SEAFOX

The German company Atlas Elektronik has developed one of the best-selling expandable mine disposal systems (EMDS) based on the SEAFOX vehicle. This system was developed as a cost-effective unit with considerably reduced mission time, compared to recoverable ROV methods. It has been developed in two versions: the combat expandable (SEAFOX C) and the reusable identification (SEAFOX I). The vehicle is fully qualified by the German Navy and other NATO authorities, and is in service with 11 customers, including Belgium, Estonia,

Photo: Saab

Last January, Saab received the first order from Thales as prime contractor for the Franco-British MMCM programme for the Multi-Shot Mine Neutralisation System (MuMNS).

Germany, Japan, Sweden, the Netherlands, US, UK, Finland, UAE, and Thailand. It operates on more than 70 platforms and shore-based applications according to Atlas Elektronik. The SEAFOX is small, weighing 40 kg and is equipped with a 3,000 m-long fibre optic cable, a sonar and camera for target reacquisition and identification, as well as a fully qualified small shaped charge for target neutralisation. The SEAFOX is also equipped with the same company provided COBRA EDO-tool for the safe and reliable disposal of historic explosive ordnance, and is effective against ground, moored and drifting mines.

The Swedish Saab Group, through its Underwater Defence Systems division has long experience in the MCM remotely controlled and autonomous underwater vehicles through its family of DOUBLE EAGLE, AUV62MR and MuMNS systems. The latest addition to the DOUBLE EAGLE MCM ROV family, in service with eight countries, including Denmark, the Netherlands, France, Finland, Australia, Belgium, Poland and Sweden, is the SAROV version. This can be operated as a ROV using two different tethers: one with a thin fibre tether for real-time communications and long-range missions (12 km) with power supplied by its internal LiPo battery, providing 10 hours endurance. The other is a combined power and communication tether, with a standard length of 1,000 m for long endurance missions. As an AUV, the vehicle can operate independently of the ship with an obstacle avoidance capability with pre-planned instructions downloaded before launch or transmitted via wireless communications while surfaced. With a length and width of 3 m and 1.3 m respectively, the DE SAROV version can reach a depth of 300 m and can carry a 250 kg load, including sensors and a DAMDIC disposal charge. The AUV62 MR is the mine reconnaissance variant of the 53.3 cm diameter AUV62 family, which is operational with the Swedish Armed Forces. Each MR-vehicle is equipped with a pair of flank array sonars, suitable for high-resolution bottom imaging using dual multi-element interferometric side looking sonar, conventional beamforming for REA operations and onboard synthetic aperture sonar processing offering a 5 cm x 5 cm spatial resolution and compatible area coverage rate.

Photo: Saab

The Saab AUV62 MR is the mine reconnaissance variant of the 53.3 cm diameter AUV62 family of UAVs, which also includes target and mine variants.

The MuMNS

In January 2021, Saab received the first order from Thales as the prime contractor for the Franco-British Maritime Mine Counter Measures (MMCM) programme for the Multi-Shot Mine Neutralisation System (MuMNS), with first deliveries taking place in 2022. The MuMNS is a new generation mine neutralisation and immunisation system based on a highly manoeuvrable six Degrees of Freedom (DoF) ROV capable to be installed and remotely operated from a range of craft, including unmanned surface vehicles (USVs). The MuMNS is equipped with advanced sonar and camera sensors to relocate and correctly identify underwater targets including mines, depth charges, torpedoes and underwater improvised explosive devices. The MuMNS can carry three MNS chargers at a time. These come in a variety of forms, including shaped charge, immunisation and a training unit. The charges are deployed by the MuMNS's retractable arm designed to attach the payload to the target, before the ROV repositions at a safe distance. A radio frequency receiver connected to the charge is then disengaged remotely, floating to the surface by a tether up to 300 m long, before being initiated from the USV or vessel via a RF signal. The MuMNS offers different advantages compared to conventional MDS, including being equipped with three MNS which allows for a single mission to manage three targets, reduced operating time and multi-mission capability.

The BAE Systems group, through the acquisition in 2019 of Riptide Autonomous Solutions company in the US, is offering the Riptide family of UAVs, including the MICRO class, the UUV-7 and the UUV-9. These one-to-two man portable vehicles are joined by the new UUV-12, which has significantly expanded the capabilities of the Riptide AUV family, already procured by the US Navy and other government agencies. When integrated with the company's mission system payloads, it can accomplish a wide range of missions, including IPOE and ISR. ■

The Global Submarine Fleet and Weapons: Present and Future

Bob Nugent

This article looks at the present and future of the global submarine force, drawing on proprietary data from naval market analysis and advisory company AMI International. It is a look at submarines now in service around the world, including regional balances and breakouts by propulsion type.

The submarine has evolved steadily over the last century, from a fleet auxiliary and commerce raider to a "battle line" platform central to many navy force structures around the world. The submarine is also receiving a larger share of budget expenditures on new construction ships. This is understandable as the submarine's advantages of stealth, greater endurance (in both nuclear and conventional propulsion variants), and increasingly potent anti-ship missile armaments make the submarine an attractive force multiplier investment for navies.

Looking at the size of today's global submarine fleet, a first impression is that significant capability and resources are concentrated in a relatively few number of platforms. How few? The world's current operational submarine inventory of 509 hulls represents just over 4% of the 14,000 ships and craft AMI identifies as in service with navies and other sea services today.

This small proportion is overstated somewhat, since that inventory of 14,000 includes almost 11,000 hulls that are less than 1,000 tonnes (full load displacement). However, even among larger ships more representative of ocean-going navies, submarines make up only 15% of fleet structures on average.

Photo: Saab

Submarines are the most expensive platform navies buy on a ton-for-ton basis.

In navies that prioritise submarines in their procurement plans, such as the United States and Russia, the proportions of submarines making up naval forces are still small. Among Russia's 485 ships in service over 1,000 tonnes are 61 submarines – some 12%. In the United States, 69 of 489 ships larger than 1,000 tonnes, about 14%, are submarines. A similar comparison of the proportion of subs to larger ships in service with other navies supports a similar conclusion: submarines make up only a small portion of naval orders of battle around the world.

A more detailed regional assessment of today's submarine forces shows that most of the type are concentrated in the Asia-Australia region, with some 44% of the active inventory. This is a result of the region containing more countries in AMI's grouping (23), as well as the high concentration of older submarine hulls in North Korea. Of the 47 active submarines in North Korea's force, 35 of them are more than 30 years old.

That said, the Asia-Australia region is among the most dynamic in the world when it comes to submarine programmes and forces. For example, Japan has maintained a force of 22 active submarines ranging from 3,000-4,200 tonnes, and keeps that fleet modern, with an average hull age of 12 years. China's modern submarine force (those built since 1990) numbers 52 hulls, with an average age of 17 years. India has also maintained a steady commitment to submarines, with 17 in service. However, complications and delays in that nation's new submarine programs has resulted in an older forces, half of Indian subs having been commissioned prior to 1990.

NATO navies (the region does not include the US in AMI's regional composition) also continue to maintain submarine fleets in a sizeable aggregate number of 76. In the region, the UK and France continue to lead in terms of submarine numbers, sizes and capabilities (each with 10 subs, including nuclear powered strategic platforms – SSBNs--respectively). Navies such as Germany's, Italy's and Spain's continue to sustain sub forces of 4-6 hulls each.

Author

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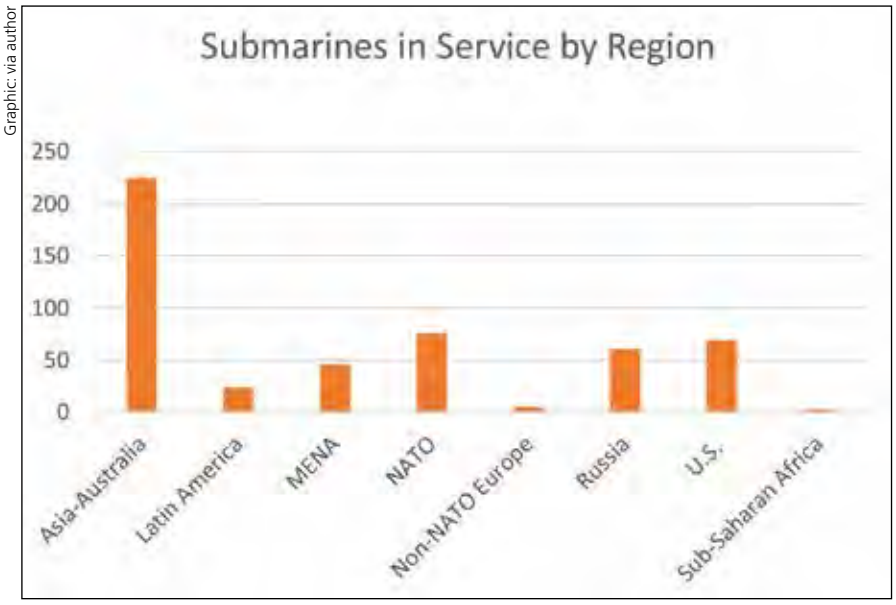
	Region	Asia-Australia	Latin America	MENA	NATO	Non-NATO Europe	Russia	U.S.	Sub-Saharan Africa	Total
Propulsion										
Conventional		215	24	46	56	5	21	0	3	370
Nuclear		10	0	0	20	0	40	69	0	139
Total	509	225	24	46	76	5	61	69	3	
%of Global		44%	5%	9%	15%	1%	12%	14%	1%	100%

As noted above, both the US and Russia maintain the largest and greatest number of active submarines. Together with the UK and France, the US maintains the distinction of operating an all-nuclear submarine force. In Russia, nuclear propulsion subs are about two-thirds of the inventory.

Graphic: via author



Outlook for Submarine Construction

Despite their small numbers, submarines continue to represent the most expensive platform navies buy on a ton-for-ton basis. This trend influences future submarine procurements, as a decision to invest in a new class of submarines often means foregoing acquisitions of even larger numbers of surface ships and craft. Moreover, the competition for new ship acquisition resources is typically keen, both between proponents of submarines and surface ships, and with other claimants for budget resources, notably Air Forces seeking advanced aircraft.

A look at AMI's forecast of numbers and acquisition costs of new submarines over the next two decades demonstrates this reality. New submarine procurements through 2040 show that submarines represent just over 10% of all new ship platforms AMI forecasts will be acquired. Regional totals vary from 30% of forecasted new construction (Russia) to 0% (Sub-Saharan Africa). The average for the US, NATO and the Asia-Pacific regions is about 8-10% of all new naval ships acquired—close to the global average of 10%. However, this 10% of all new naval ships types represents 34% of all new spending (US$Bn of a forecasted one trillion in new shipbuilding).

A comparison of the number of new hulls planned with the age of the submarines they are intended to replace also highlights both the higher costs of submarine acquisitions, and continued commitment to spend the resources to keep those forces modern. The numbers of subs likely to leave service over the next 2 decades due to age is estimated to be about one-third to one half of current inventories, between 150 and 250 hulls. Over the same period, 300 or more newly- constructed submarines are forecasted to enter service.

As noted above, countries like China, Japan and India all have submarine construction programs in place, and are investing to replace their retiring submarines with new hulls on a one-for-one basis or better. This highlights how naval planners and budget officials both recognise their return on investment in submarines, even at the expense of giving up some surface ship construction plans within fixed or marginal growth budgets.

These figures establish the submarine segment one of the few in today's naval market that is growing, where new hulls will replace retiring hulls at 1-for-1 or greater ratios. From these numbers, the operational submarine fleet of 2040 worldwide will be larger than the just over 500 hulls in service today, perhaps by as much as another 100 hulls.

Graphic: via author

Forecasted New Builds Estimated Ships to be Procured by Navy or Coast Guard service thru 2038	*New Submarine Hulls*	*Total new ships acquired*	*Share*
Asia & Australia	112	*1089*	*10.28%*
Caribbean & Latin America	15	*248*	*6.05%*
Middle East & North Africa	21	*306*	*6.86%*
NATO	63	*632*	*9.97%*
Non-NATO Europe	5	*58*	*8.62%*
Russia	55	*182*	*30.22%*
Sub Saharan Africa	0	*46*	*0.00%*
USA	44	*503*	*8.75%*
Totals	***315***	***3064***	***10.28%***

These upward trends in submarine acquisition are also good news for the submarine modernisation market. Many of the conventionally-powered submarines expected to retire from service in the next two decades will still be candidates for modernisation and upgrade after sale. Such modernisations would prepare the submarines for second owners, whether they be navies with established submarine arms, or countries seeking a lower cost and lower risk path to standing up a submarine force for the first time.

Developments and Trends in Submarine-Launched Weapons

Submarine armament is seeing a wave of new weapons and technologies. Traditionally armed with torpedoes, mines and missiles, the focus of effort for new submarine weapons today is the missile.

The history of equipping submarines to launch missiles dates back more than half a century, to work in the US, Soviet Union, and other nations in the 1950's to mount a variety of missiles on submarine hulls, particularly submarine launched ballistic missiles (SLBM). However, the pace of work to equip submarines and new launch modes appears to be quickening. In the 12 months between March 2020, and March 2021, China (JL-3 SLBM), North Korea (PUKGUKSONG-5 SLBM), and India (K-4 SLBM) all showed and/or tested new types of submarine missiles.

While SLBMs with nuclear warheads represent the most destructive example of submarine launched missile, new models of anti-ship missiles mounted on submarines are a more immediate concern for naval leaders, as such missiles have a lower threshold for use. Further, navies have repeatedly demonstrated the intent to use anti-ship missiles when that capability is present.

AMI's data on the 509 submarines now in service worldwide show that 311 of them (some 60%) are assessed as equipped with some kind of missile. The HARPOON remains the most prevalent anti-ship missiles on submarines today, with 82 hulls assessed as capable of launching the missile. While the US Navy had retired the submarine-launched HARPOON over 20 years ago, by 2018 the weapon was once again fired in a sub-launched mode. Statements from US Navy leaders since have confirmed Boeing has been contracted to refurbish Block 1C HARPOON missiles to be delivered for operational service beginning in late 2020.

China, India and Russia also continue to invest in new submarine launched anti-ship missiles. The CM-708 UNB, reportedly a longer-range (80-90 Nautical Mile) variant of the YJ-82 ASCM, was exhibited by China Aerospace Science and Industry Corporation (CASIC) in 2018. India demonstrated a sub-launched version of its BrahMos missile in 2013. More recently (November 2020), India has conducted tests of longer-range upgrades of the BrahMos that likely include a submarine-launch option. Russia, a country with a long pedigree of submarine-launched anti-ship missile development, continues to refine the KALIBR family of anti-ship missiles. Recent US naval assessments indicate the Pacific Fleet's submarine force will receive the missile for the first time in 2021.

Conclusion

The submarine's influence on naval warfare has been profound in the last century. Trends and statistics presented in this article promise that influence will continue to grow over the coming two decades. More submarines, in more navies, with more missiles at longer ranges combine to pose significant challenges, as well as opportunities, in the realm of national security and defence. ■

Babcock Technology at the Heart of Future Proofing Submarine Launch Capabilities

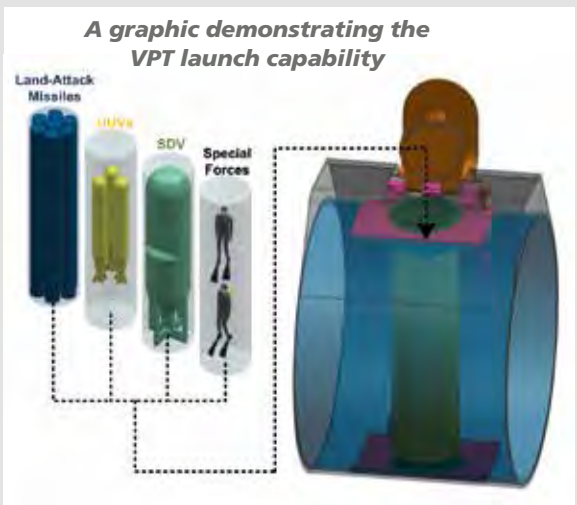
Babcock International, the Aerospace, Defence and Security Company, has been responsible for the design, manufacture and support of submarine Weapon Handling and Launch Systems (WHLS) for the Royal Navy and overseas customers since the 1970s. This experience has provided Babcock with a unique insight into the challenges faced by Navies in trying to ensure that their new submarine platforms have future proof capabilities to allow them to respond to emerging threats during the life of the submarine. New submarine build programmes typically last decades, whilst the requirements of these new submarine platforms can change in a much shorter time frame. It is therefore not uncommon for Navies to find that the role of their new submarines has changed by the time they enter service.

Since 2006 Babcock has worked closely with Navantia to develop WHLS and countermeasure defence solutions for the Armada Española's new S80 class submarine - the first of which, the S-81 Isaac Peral was launched late April 2021. As an independent supplier of submarine WHLS, with the broadest experience of integrating weapons and payloads, Babcock was the ideal supplier to support Navantia with their indigenously designed S80 submarine programme. This has resulted in the development of a WHLS and countermeasure defence solutions that will provide the Armada Española with the most flexible launch capability throughout the life of the platform; with the capability to launch torpedoes, missile, mines, countermeasures and future payloads.

Looking to the future, many navies around the world are considering the benefits of building submarines which have multi-role capabilities enabled through the use of Vertical Payload Tube (VPTs) and hosting of Unmanned Underwater Vehicles (UUV). Babcock is at the fore-front of the development of the new and innovative solutions and is working on a number of internally and externally funded projects to progress these state of the art of these technologies.

Babcock has been developing a Vertical Payload Tube (VPT) solution for submarine platforms since 2010. Our VPT system is designed to be modular in order to deliver a highly flexible payload hosting system; capable of hosting Tomahawk Land Attack Missile (TLAM) canisters, Unmanned Underwater Vehicles, Swimmer Delivery Vehicles and providing a Special Forces lockout capability. Babcock's VPT system will enable the submarine to have a multi-role capability throughout its life, beyond those typically delivered by the traditional Weapon Launch Systems.

Photo: Babcock



Externally hosting Extra Large Unmanned Underwater Vehicles (XLUUVs) from submarines may have the potential to deliver a significant force multiplier to a navy's submarine operations. However, effective integration of the hosting solution onboard existing and future platforms provides a challenge. Babcock is currently developing, trialling and de-risking an XLUUV handling system for submarines.

Unmanned Forces: Achieving ORBAT Balance

Giulia Tilenni

The importance of unmanned systems in modern warfare has been proved for decades now and their role is evolving further. The growing number of users and types of unmanned systems available on the market are profoundly reshaping the integration of these technologies in Armed Forces' Orders of Battle (ORBAT).

A useful force multiplier in wartime, unmanned vehicles are widely used in peacetime as well, mainly for intelligence, surveillance, and reconnaissance missions (ISR). The main advantage of using unmanned systems rather than manned ones remains unchanged regardless of the operational environment and the mission performed: with no crew on board, there is a consequent reduction of risks for troops. Limited purchasing and operational costs are usually invoked as an additional advantage of these systems. Despite remaining cheaper than manned assets, their cost varies according to the complexity of the system.

Coupled with the relevant support that unmanned vehicles bring to their users, these features have boosted the willingness of armed forces to include them in their inventories. Hence, several tendencies can be observed concerning their integration into ORBATs.

The deployment of unmanned vehicles, especially UAVs, has dramatically increased in recent years for the smallest types. Indeed, a broader offer has allowed countries with limited military budgets to procure these assets. For the same reason, however, non-state actors also have easier access to unmanned technologies. In the past, these were purchased on the civilian market (commercial UAVs), then modified for military purposes (for instance with explosive charges). More recently, groups such as Hezbollah or the Houthi rebels have had access to off-the-shelf military models (Iranian-made in both cases) and have acquired some autonomous development capabilities.

Author

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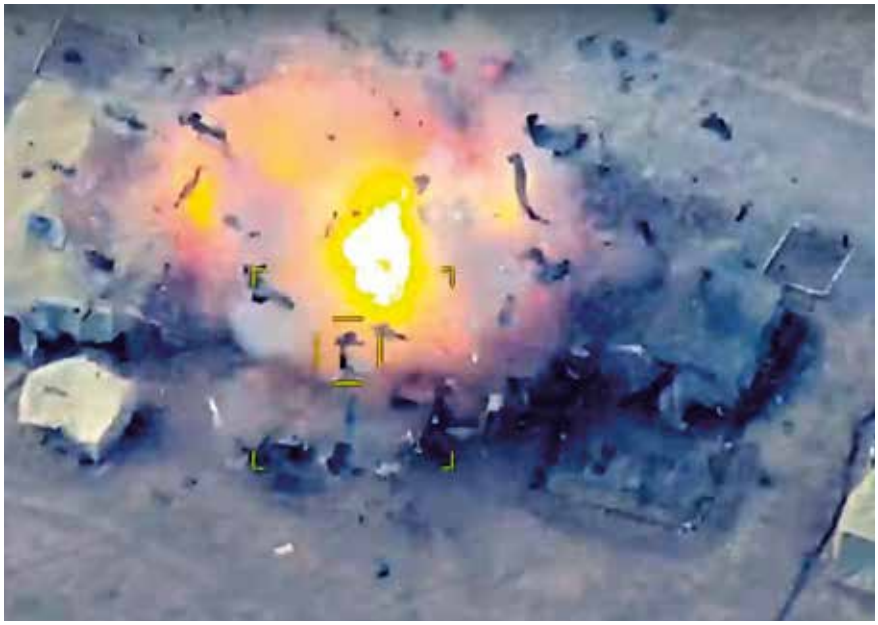
Photo: MoD Azerbaidshan



A HAROP Loitering Munition hits an Armenian military camp during the Second Nagorno-Karabakh war.

An additional and particularly relevant trend noticed recently is likely to be a game-changer with the integration of unmanned vehicles into ORBATs: namely, the redeployment of UAVs in conventional conflicts. For a long time now, the lack of kinetic countermeasures has been considered as a main weakness in these unmanned systems, whose use was limited to asymmetric warfare and non-contested airspace. However, as will be detailed below, the recent conflict in Nagorno Karabakh has highlighted the role of UAVs in conventional conflicts as well.

ORBAT Integration: a Variety of Systems and Multiple Uses

The panoply of unmanned systems available on the market allows for different levels of ORBAT integration, mainly according to available budgets, operational requirements, and the technological level of the different armed forces. We can imagine the integration of these systems as a sort of pyramid:

- The base of the pyramid includes small and simple systems, which are now widespread and provide useful, yet limited military support to users. They can ensure basic missions, such as time-limited ISR operations, and they can also drop small explosive charges/bombs or used as bombs themselves. For instance, "modified" commercial systems, adapted for military purposes, mainly used by terrorist groups, may be viable solutions for countries subject to embargoes or with limited budgets. The unmanned systems that the Houthi rebels used against Saudi Arabia in 2019 provide a good example.

- The upper level is formed by legacy systems and loitering munitions. They are used for the same kind of missions, but they are employed more in terms of endurance, service ceiling and payload, thus bringing more added value and greater impact to a military campaign. For instance, they can clear a site before the arrival of troops or gather relevant information before and/or during the mission. The fact that countries such as China, Turkey, Iran, Pakistan, and others have acquired sufficient technical knowledge to produce unmanned vehicles provides countries with limited budgets and/or modest armed forces with the opportunity to purchase these technologies, usually without strings attached. Consequently, this level is broadening.
- The apex of the pyramid includes the limited club of countries using state-of-the-art unmanned technologies, in armed and unarmed versions, for complex and lengthy missions. In this case, their integration into ORBATs becomes a relevant force multiplier.

The real innovation lies in their operational use. For the time being, the pace and impact of technical developments seems slower than innovative uses of these systems in military missions. Two main trends can be observed: one, concerning the type of conflicts; and the other, related to collaborative missions.

The 2020 conflict in Nagorno-Karabakh represents a game-changer in the deployment of unmanned systems on the battlefield, as this is considered to be the first use of unmanned technologies in a conventional conflict setting. UAVs, and in particular loitering munitions, had been already used in an earlier phase of the conflict, in 2016. In September 2020, however, Azerbaijan's UAVs destroyed Armenia's remarkable array of ground-based air defence (GBAD) systems first, then Yerevan's land forces materiel, including tanks, artillery pieces, and supply trucks. In other words, unmanned vehicles have replaced manned systems for attack and close air support (CAS) missions in a regular conflict for the first time.

Photo: via Georg Mader / Baku Media Center

A container storing HAROP loitering munitions

Photo: via Georg Mader

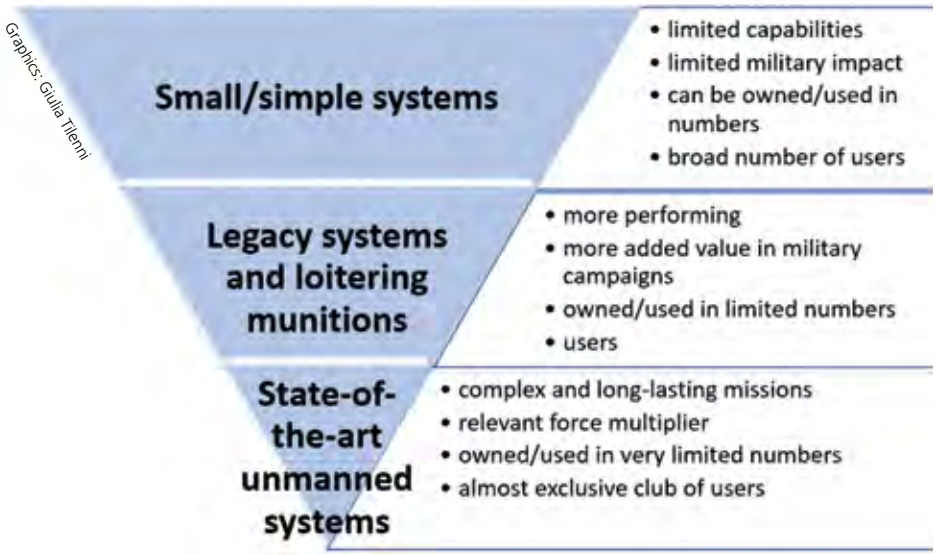
In the meantime, the way in which unmanned systems are used on the battlefield has been evolving as well. In the past, these were mainly deployed on standalone missions or to support manned ones. This meant, for instance, that unmanned systems were sent to gather relevant information or to clear a site before the beginning of a mission. When used during a mission, unmanned systems can provide continued ISR/ISTAR support, carry out bombing missions, or serve as a relay service.

Over time, collaboration is slowly becoming more commonplace. For the time being, swarming represents the main type of cooperative use of unmanned systems in all operational environments. When this technique is used, unmanned vehicles work as a fleet, and each of them operates to achieve a given, common objective. The more unmanned systems are autonomous, the more effective the swarming will be.

As we will see, increasing unmanned systems' autonomy on the battlefield will likely be the driver of a new revolution in military affairs, in technological, but especially in strategic terms: the development of remote carriers for manned/unmanned teaming.

The Future of Integration

Cooperation between unmanned and manned systems is at the core of research for next generation fighter aircraft. Both Airbus and Boeing are working, respectively, on the development of remote carriers/loyal wingmen. Two terms stemming from the same definition: developing unmanned aerial systems with different specialisations and a certain degree of autonomy, to be fully integrated within



Graphics: Giulia Tilenni

The ORBAT balance pyramid

the fighter's architecture. The aim is to increase the combat mass needed in highly contested environments while limiting the risks for the pilot and the manned platform. In such an architecture, the family of unmanned vehicles serves as a force multiplier for the fighter aircraft.

Not surprisingly, this represents an enormous technical challenge, in which communication, AI and machine learning, and the level of autonomy that they can generate, are the main issues to be considered.

Unmanned assets need to communicate in an agile and robust way with manned platforms, thus requiring the development of datalink and cloud solutions, and advanced sensors fusion. The choice between putting computing capacity on-board or off-board is also part of the issue.

AI and machine learning are at the core of the whole system, as they have a direct impact on the level of autonomy that each unmanned system will have. In addition to risk mitigation, one of the main strengths of manned/unmanned teaming will be delegating tasks to unmanned systems. The pilot will be able to communicate a mission profile (electronic warfare, attack, defence, etc.) to the whole family of systems participating in the mission. Each of them will translate this meta-command into action by picking the good configuration according to known scenarios. Machine learning will allow unmanned systems to increase their knowledge, while AI will "help" them to take more effective and rapid choices. Thanks to this new decision-making process, the pilot can focus on high value-added tasks and let unmanned systems do the rest.

Communication and autonomy through AI/machine learning are the most disruptive technical issues for unmanned/manned teaming. However, creating an efficient set of systems requires other issues to be considered, especially when it comes to countermeasures. Existing unmanned vehicles lack several important features such as low-observability and protection from cyberattacks. So far, users have preferred to limit the use of unmanned systems to non-contested air space and asymmetric conflicts rather than finding technical solutions. However, tackling these issues will be of the utmost importance for developing an effective manned/unmanned teaming, as users will be forced to prevent the enemy from exploiting such weaknesses.

Autonomy vs. "Ethics"

The issue of autonomy has always been most disputed when it comes to unmanned vehicles. When originally used,, confusion arose surrounding the concepts of autonomy and remote piloting, with critics decrying the arrival of killer weapons.

For a long time, the absence of a "man in-the-loop" did not mean that unmanned vehicles were able to act autonomously, especially in armed configurations. However, the situation will most likely change with the most recent technological advances. The ongoing research on AI and machine learning in the light of manned/unmanned collaboration demonstrates that the so-called "lethal autonomous weapons systems" have become a reality, at least from a technical perspective. If most companies are currently focusing on providing unmanned systems with a limited degree of autonomy, it will be easier to increase the level of autonomy once the technical architecture is created. It will therefore be up to states to choose how far they would like to push the issue of autonomy for unmanned systems. In other words, users developing autonomous systems will have to make a clear political decision on this sooner or later. China and the US have already declared that they would not put any ethical limit to technical developments concerning autonomy.

Final Considerations

The discussion on how to achieve ORBAT balance when it comes to unmanned technologies is far from being an easy task.

For small states with medium-sized or not fully developed armed forces, having unmanned systems in their inventory and being able to deploy them on missions will already be an important indicator of success. For states deploying the most technologically advanced armed forces, being able to deploy fully autonomous fleets of UAVs able to operate in a swarming capacity, without any human intervention, could become a reality in the next decades.

Several possibilities exist between these two extremes: using unmanned systems in addition to manned ones without any form of collaboration, using small unmanned systems with a swarming profile, trying to develop some collaboration between unmanned systems and legacy fighters without changing the existing decision-making architecture.

In any case, unmanned systems will likely be at the heart of a new revolution in military affairs, though this time based on autonomy. As we have seen, the more technically advanced the system, the more the pilot will be able to delegate tasks to it. A scenario that will totally change the existing decision-making process. This brings the undoubted advantage of fully exploiting unmanned systems' computing abilities (faster than a human brain) to let pilots focus on the most important choices, the ones which still require judgement. However, this latest point will remain one of the most sensitive issues. In the mid-to long term, each user will be called upon to make a political choice on the degree of autonomy it wants to give to its unmanned systems. Ultimately, politics will likely be the only technical limit to the development of autonomous features. ■

Photo: Suman Sharma

Terror Strikes Again in Red Corridor

Suman Sharma

Terror in the so-called "red corridor" returned to Central India in early April when 22 Indian paramilitary CRPF (Central Reserve Police Force) soldiers were massacred in a deadly Naxal ambush attack by Maoists, in Tekulguda village of Chhattisgarh State.

The Naxalites mainly operate with guerrilla style tactics, conducting ambushes and surprise attacks. It can be recalled that in 2010 in the same region, 76 CRPF soldiers were ambushed and killed by the Naxalites-Maoists in Chhattisgarh's Dantewada district. That attack created global headlines in what was considered to be the deadliest attack up until that time with the largest number of casualties suffered in a single day. Ever since, there have been fluctuating numbers of casualties inflicted by the Naxalite-Maoists each year, reaching this year's record high of 22 so far.

Former Indian Police Service officer, Yashovardhan Azad says, "Whenever there is a lull in Naxal activities and statistics are low, the feeling is we are getting a grip over Naxalism, but that's the time the Naxalites are getting a grip on the area. In Bijapur-Sukma there is tremendous work done in terms of infrastructure build-up but the Naxals use IEDs and we don't have mine proof vehicles for protection. If there is peace, then that means the Naxals are regrouping."

In a more than three-hour long operation over the Easter weekend, around 2,000 security personnel from CRPF's specialist jungle warfare units like CoBRA (Commando Battalion for Resolute Action), STF (Special Task Force) and DRG (District Reserve Guard) undertook a combing operation in the jungles of Bijapur-Sukma bordering Bastar in Chhattigarh in order to flush out local Naxal leader, Madvi Hidma. Unfortunately, the units were lured into a trap, resulting in this high loss of lives and injuries in what turned out to be a close combat exchange with sophisticated weapons used, including grenade launchers, IEDs, crude rocket launchers, and machine guns. In laying the trap, the Naxals had surrounded the security forces from three sides, a tactic they have often used, resulting in the heavy casualties; one CoBRA commando is said to have been taken hostage and some soldiers were allegedly dismembered before being killed.

India's red corridor gets its name from the Naxalite-Maoist insurgent-laden regions stretching from the eastern, central and southern parts of India covering about 60 districts in eight states - Odisha, Jharkhand, Bihar, West Bengal, Madhya Pradesh, Maharashtra, Andhra Pradesh and Chhattisgarh. Chhattisgarh is considered the hotbed of the Naxalite-Maoist insurgency with the most notorious area being the 35,600 square mile Dandakaranya forest in east Central India, while other hot spots include Bastar, Bijapur, Sukma, and Dantewada districts in Chhattisgarh state. Overall, 14 out of 27 districts in Chhattisgarh are affected by the Naxalite-Maoists insurgency. The term Naxalite itself originates from 'Naxalbari', a small village in West Bengal, where leaders of a faction of the Communist party of India (Marxist) CPI-M, initiated an armed uprising in the mid-1960s. What started as a peasant and tribal movement fighting for improved land rights, better jobs, agricultural reforms, the Naxalites, also known as Maoists, comprise armed cadres of the far-Left wing of the banned CPI-M and aim to overthrow governments. Since their formation, they have killed close to 15,000 people in the past three decades including civilians, government officials and security personnel.

Commenting on the restructuring of the security system and the need to go back to the drawing board, strategic analyst C Uday Bhaskar says, "Restructuring the leadership of the central police forces has not been addressed. By training, the police officer is expected to be a competent Superintendent and to maintain law and order. This is not the skill-set that is relevant when an officer has to "command" and lead his men into [counter] insurgency operations. In the current scenario, many of the senior police officers parachuted into the paramilitary forces at senior ranks and have little or no platoon/battalion experience. This results in the Tekulguda kind of tragedy, where absent effective leadership, when the bullets fly, the security forces panicked and abandoned both their dead and their weapons. This is sacrilegious for a fighting force."

While the federal government is being questioned for its policies, 'Bhaskar echoes what exacerbates the fight against left-wing extremism in India – the lack of will to implement recommendations and government policies, the most prominent being the KRC (Kargil Review Committee) report tabled in Parliament in December 1999. One of the report's recommendations noted: "There is general agreement that in light of the new situation of proxy war and large-scale terrorism that the country faces, the role and the tasks of the paramilitary forces have to be restructured particularly with reference to command and control and leadership functions."

Weaponised Containers Protect FOBs

Christopher F Foss

Standard ISO 20x8x8 ft and 8x8x8 ft containers are now used for an increasing number military applications, apart from their traditional role of carrying cargo.

These include use at Forward Operating Bases (FOB) as not only accommodation roles but also key missions such as command and control, cyber, briefing rooms, hospitals, intelligence, repair and storage to name but a few. They are normally transported by truck or trailer and can be rapidly unloaded using a fork lift truck or lifted by a crane into positon.
A more recent role is that of being fitted with weapons to provide a close-in defence capability at FOBs against not only ground threats but also incoming artillery, rocket and mortar bombs. In addition to containerised weapons, there also trailer-mounted systems, which can be rapidly deployed where they are needed.
Containers do however have to be modified for their new roles and as they could come under direct fire need to be protected against incoming small arms fire at least. Protection against rocket-propelled grenades can be provided by standoff protection. As they are normally fully enclosed, an environmental control system is needed which normally requires power which can be from the FOB main power supply or from an auxiliary power Unit (APU) installed in or next to the container.

Photo: Rheinmetall Air Defence

The Rheinmetall Air Defence Oerlikon SKYSHIELD air defence system is mounted on pallets so it can be rapidly deployed where it is required. The picture shows the two revolver gun mounts with the sensor unit with surveillance and tracking radars to the rear.

Streit`s Armoured Checkpoint

A good example is the trailer-mounted Armoured Checkpoint (AC) developed by the Streit Group to provide protection for high value targets such as barracks, power stations as well as FOBs. The trailer-based Streit AC is built of all welded steel armour with bullet/splinter proof windows for situational awareness which are protected by wire mesh with sliding gun ports below to allow the occupants to use their personal weapons if required. Weapon fit would depend on the end user but would typically consist of a roof-mounted manually operated cupola typically armed with a 7.62mm or 12.7mm machine gun (MG). An example of the AC shown in mid-2019 was fitted with a Romanian Digital AGIL 127 ERLF remote weapon station (RWS) armed with a Russian 12.7mm DShKM MG. This would be laid on to the target by the operator using a flat panel display (FPD) which could also potentially display information and or images from other sensors around the FOB. Mounted or the roof are four lights which could be run from an external 220 V supply or from a standby generator.
Streit are offering a number of options for their AC including air conditioning system, toilet, intercom system, fire suppression system, public address system with siren and connected to a barrier if it was deployed at the main entry point of a FOB, for example.

To further enhance the capabilities of the AC, the RWS has been shown being integrated with the French Metravib PILAR V acoustic gunshot detection system (AGDS) which is now being fitted to the latest generation French Army vehicles including JAGUAR and GRIFFON (6x6) and the SERVAL (4x4) AFV. PILAR V AGDS detects the incoming small arms fire and then rapidly swings the RWS onto the target with the operator then deciding as to whether to engage the target or not.

Leonardo`s Active Defence Components

Leonardo of Italy has supplied the Italian Army with three sets of containerised Active Defence Components (ADC) to provide a higher level of defence for FOB against close in threats. Each ADC consists of one 20x8x8 containerised Command Control Post (CCP) and six 20x8x8 Containerised Weapon Platforms (CWP) which would be sufficient to provide a

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close-in protection capability to a medium-sized FOB, but this would depend on the size of the latter.
The CCP can control up to six CWP and also receive information from other external sensors such as radars, thermal and acoustic detection devices and could also could also be tied into a counter unmanned aerial vehicle (C-UAV) systems. All of the units are air conditioned as well as an APU for self-contained operations, although in some cases they would be plugged into the FOB main power supply with the APU being used as a backup. All of the elements are fitted with automatic legs and a self-levelling system, which enables them to be deployed without any external assistance. Each of the CWP has a telescopic tower, which is raised into the operating position up to a maximum height of 8 m and can be manned or unmanned.
On top of this is a Leonardo HITROLE LITE RWS which is already used by the Italian Army in large numbers for installation of vehicles such as the Iveco Defence Vehicles LIGHT MULTI ROLE (LMV) and which can be armed with a 7.62mm or 12.7mm MG or a 40mm automatic grenade launcher (AGL). The sensor pack of the HITROLE LITE RWS consists of a zoom TV camera, a thermal camera and a laser rangefinder and enables targets to be detected and engaged under almost all operating conditions.

Photo: Christopher F Foss

Leonardo`s Containerised Weapon Platform in raised position, showing a roof-mounted Leonardo HITROLE LITE RWS armed with a 12.7mm MG

The US Containerised Weapon System

Under the leadership of the US Army Aviation & Missile Centre, a Containerised Weapon System (CWS) has been developed and tested. This consists of a self-contained ISO Tricon shipping container with an electrically operated telescopic mast on top of which is mounted a Kongsberg PROTECTOR RWS armed with a 12.7mm MG and a Lockheed Martin/Raytheon JAVELIN anti-tank guided weapon (ATGW). A situational awareness computer provides a networked hub linking the CWS to existing Intelligence, Surveillance and Reconnaissance (ISR) assets for a "rapid, automated target cueing."
CWS can be deployed by two troops in less than 30 minutes and be operated by remote control up to a distance of up to 1,000 m. This was part of the US Army Base Defense Response System (BDRS) requirement which has been updated to form a larger Mobile Force Protection Response System (MFPRS) which is still ongoing.

Rheinmetall`s SKYSHIELD

While not a strictly containerised weapon system, the Swiss Rheinmetall Air Defence Oerlikon SKYSHIELD 35mm gun system is mounted on pallets which can be transported by trucks and rapidly unloaded and can protect FOBs against a variety of incoming threats including unmanned aerial vehicles (UAV), rockets and mortar bombs. One unit would typically consist of one command post, one sensor unit and two unmanned SKYSHIELD 35 Advanced Hit Efficiency and Destruction (Ahead) Revolver Gun Mounts. The first customer for this was the German Army, but these were subsequently transferred to the German Air Force who controls all air defence assets and calls this system the MANTIS. It has also been exported to a number of customers with the 35mm AHEAD ammunition being highly effective against UAV's.
The then Oerlikon Aerospace of Canada did develop a containerised version of its Air Defence Anti-Tank System (ADATS) and this was sold to Thailand, but all marketing of ADATS has ceased and the M113 series version of ADATS deployed by Canada have now been withdrawn from service.

Photo: US Army

A first example of the US Army`s Containerised Weapon System with mast raised, showing a PROTECTOR RWS armed with a 12.7mm MG and a JAVELIN ATGW

Russia and China

The Russian Agat Joint Stock Company has developed a 20x8x8 containerised version of its CLUB-K anti-ship missile system which can vertically launch 3M-54KE, 3M-54KE1 or 3M-14KE missiles or the Kh-35UE sub-sonic cruise missile which is inclined prior to being launched. Before launching the missiles the container would have to be securely anchored to the ground, roof and rear opened up and target information fed into the missile from the associated command and control system, which would be linked to a radar or other sensor.
China has also shown the example of a 20x8x8 container carrying pods of surface-to-surface rockets, which could be used in a standalone configuration or carried on the back of a truck but with the sensors and command and control unit stored elsewhere. ■

New Technologies Disrupting Long Range Infantry Weapons

Tamir Eshel

The technological changes introduced in recent years are disrupting the human warfighter's capabilities beyond anything we have known in history.

At first, warfare was based on human physiological capabilities - primarily strength and stamina. Then, men harnessed nature and science in making tools to increase their powers – the spear, the bow and arrow, each extended their range and increased the lethality of the warrior against beasts and other humans. Since these weapons had to be operated by the warfighter at any time and any place, they had to be matched to the human ability to carry and control (portable), intuitive to use (simple), and maximise lethality against the specific target. Maximising energy flow/area by using a pointed-tip spear or employing a quick-reaction toxin to incapacitate a target are just a couple of examples.

Through millennia of warfare, military technology has evolved, but infantry warfare principles remained unchanged, as human physiology has not changed meaning the weight which a human adult can carry, the speed they can run, and how far they are able to throw an object. The extension in range and lethality was the invention of the bow and arrow, and a few centuries later – firearms. Until the late 20th century, these rules were applied to all infantry capabilities. However, the technological changes introduced in recent years, primarily miniaturisation of energy storage, propulsion, and guidance systems, are disrupting the warfighter's capabilities beyond anything we have known in our shared history.

Photo: Tamir Eshel

HERO-20 is the smallest member of the HERO loitering weapon system family. Its missile-shaped design enables a soldier to engage a target from 10,000 metres away.

Photo: MBDA

The ENFORCER missile is a 'fire and forget' precision guided missile operated by a single soldier. Firing tests demonstrated its capability to hit targets 2,000 metres away.

A New Set of Cards

Today's infantry weapons have evolved to become much more complex systems, but they are still required to follow these rules: portability, simplicity, and lethality. With the modern military capability based on firearms technology, a rifle's weight and associated ammunition should meet the portability requirement. While combat loads of over 36 kg are standard, and greater loads over 45 kg are very common, it includes all the supplies carried by the warfighter; therefore, the weight allowance for a single weapon ranges from a few kilogrammes to 15 – 20 kg for a specialised weapon. Anything above that needs to be split into separate sections that must be assembled before use. The range of individual weapons (5.56x45 or 5.45x39 mm assault rifles, 40 mm grenades and RPGs, and other rocket launchers) is maintained at 300 – 500 metres. There is no minimum range for such firearms. To reach the maximum range with adequate lethality (to penetrate body armour), modern weapons need

more energetic ammunition that requires larger calibre and heavier barrels. The US Army's move from 5.56 mm to 6.8 mm is seen as a step in this direction.

To operate at an extended range, weapons need better sights and more skilled users. Working in teams of two, they can effectively engage targets beyond 1,000 metres, thereby defeating enemy targets that may be putting the infantry element at risk. Some ammo/weapons combinations that can reach 1,700 – 2,200 metre are designated 'anti-material rifles' as they are used against personnel in lightly armoured vehicles or crew members, or commanders exposed in cupolas of heavy armoured vehicles. While there is no minimum range for such weapons, since they are rather cumbersome, a user would turn to a sidearm if drawn into a close-quarters battle.

Crew-served weapons often provide fire support at extended ranges, supporting infantry teams in direct contact. These may include heavy machine guns and grenade launchers; the latter use medium and high-velocity ammunition to deliver grenades bursting up to 2,200 metres. To improve accuracy and terminal effect, a fire control system and airburst ammunition are set by a time fuse synchronised to the range ballistic trajectory. When it explodes, it scatters 1,200 fragments over the target for maximum lethality. Airburst grenades produced by Nammo, Rheinmetall, and Aselsan have an effective range of 1,500 - 2,200 metres and can defeat exposed targets inside buildings or behind cover, as well as drones. These grenades are required to travel a certain distance before arming. That is why they are usable beyond 50 metres. The Russians tend to favour the traditional direct attack engagement using their AGS-30 2nd Generation Automatic Grenade Rifle, firing the VOG-30 grenade with an impact fuse, generating fragmentation or anti-personnel effect that can penetrate infantry body armour at 2,100 metres. The AGS-30 2nd is controlled manually by an optical sight or radar.

Loitering Munitions

The same effect can now be delivered in a much more agile way using miniature tactical loitering munitions, such as the SPIKE FIREFLY from Rafael. The FIREFLY combines a miniature rotorcraft and electro-optical reconnaissance and targeting system and a warhead using fragmentation omnidirectional charge with 35 grammes of explosive, delivering an effect similar to an M26 grenade. The FIREFLY enables a single operator to provide precision strikes beyond the line of sight, at a distance of 1,000 metres in open terrain or 500 metres in an urban area. The FIREFLY system comprises three munitions, weighing 15 kg. Uvision Air, another Israeli company specialising in loitering munitions, is developing the HERO-20 LM, using an electrically propelled quad-wing missile-shaped munition with 20-minutes endurance and an operational range of up to 10 km.

SIG Sauer developed a new lightweight machine gun and carbine, chambered in 6.8 mm hybrid ammunition for increased penetration at greater distances with increased velocity and accuracy.

Rocket Propelled Grenades such as the Russian RPG, WIRKMITTEL 90 from Dynamit Nobel, AT4, or the CARL GUSTAF weapon system from Saab, are also effective at a few hundred metres but can be used against large fixed targets (such as buildings) at greater distances. The infantry may turn to 'miniature missiles' to engage targets beyond this range – a new category of anti-armour and anti-material guided missiles designed for dismounted operations. The MBDA ENFORCER, Rafael SPIKE SR, and Roketsan's YATAGAN are representatives of this new family. The first two use customised launchers and advanced electro-optical guidance enabling 'fire and forget' capability engaging targets up to 2,200 metres. The ENFORCER system weighs 12 kg (7 kg per missile) compared to 10 kg of the SPIKE SR that uses a clip-on sight to display the missile's sensor image for aiming. At a weight of about 1 kg, the YATAGAN employs standard rifle grenade launchers and semi-active laser guidance to operate. However, it requires the user to keep the target in sight through the engagement at about 1,000 metres.

Traditionally, reaching beyond that range required heavier weapons and larger crews. These included guided missiles such as the SPIKE LR (25 kg, 500 - 5,500 m range) or KORNET-E (64.5 kg, 5,500 m). Due to their weight and size, dismounted operations of these weapons require assembly in the field and, therefore, are optimised for operation in an ambush or support role.

Covering a similar range to the modern guided missiles, 81/82 mm mortars are also available to support the infantry at medium ranges. Weighing merely 13 kg, the Russian 2B25 mortar can fire the 3V035 silent fragmentation bomb with an almost unnoticeable sound effect, but its range is limited to 100 - 1,200 metres. The manufacturer


Photo: Rosoboronexport

The Russian OSV-96 rifle enables precision firing at long ranges. Its 12.7x107 mm sniper cartridges are effective against personnel at a distance of 1,200 metres. It can also engage vehicles or helicopters at 1,700 metres.

Photos: Israel MOD

The IRON STING that has recently completed trials with the Israel Defense Force (IDF) is a 'networked precision fire system' enabling the infantry battalion firing mortar munitions with high precision, using a combination of laser and GPS guidance.

Bruvestnik also develops a 60 mm version of the silent mortar, weighing 16 kg, and capable of firing bombs up to 4 km. Larger mortars may be based on manned or unmanned vehicles using articulation or hydro-mechanical recoil dampening systems. Elbit Systems' SPEAR and SLING vehicular mortar mounts are autonomous mortar systems firing smoothbore 120 mm mortar bombs at a maximum range of 8,000 m. The SLING uses a mechanical articulation system to deploy the mortar in a ground position while the laying procedure is done automatically through the fire control system. The SPEAR also uses a recoilless 120 mm mortar assembly mounted on the vehicle, firing standard mortar bombs at a range of 8 km and extended range bombs in excess of 10 km. Using the IRON STING laser and GPS-guided munitions recently qualified by the IDF, the SPEAR and SLING can deliver a 10.8 kg fragmentation warhead to hit a pinpoint target at a distance of 12 km.

Drones

Looking to the future, we have already witnessed the signs of change using drones on a wide scale in all recent conflicts. Today, military needs and commercial technologies are merged to create sophisticated, yet highly accessible, affordable weapons that meet the dismounted warfighter's portability needs, operating simplicity, and lethality. Loitering weapons are positioned to be the most disruptive, primarily the First-Person View (FPV) that has become an off-the-shelf product with the release of DJI-FPV. This system redefines drone flying. It enables the operator to fly the drone using virtual reality goggles to fly the drone as if they were seated inside, using intuitive head and motion controls. While DJI-FPV is a commercial drone opening exciting new adventures for drone enthusiasts, the hyper-advanced technology they use paves the way for new weapons that will disrupt human warfighting capabilities unless we find adequate countermeasures to keep them in the category for enthusiasts. ■

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4x4 Scout and Liaison Vehicles

Sidney E. Dean

Reconnaissance and liaison vehicles come in various configurations and capability sets, from very lightweight and maneuverable scouts to larger protected vehicles suitable for deep strike operations. This article elaborates on 4x4 wheeled systems.

The US Army had been planning to acquire a new dedicated Lightweight Reconnaissance Vehicle (LRV), but has postponed that effort indefinitely because of budgetary conflicts. In 2016, the Army announced plans to utilise the Joint Light Tactical Vehicle (JLTV) as an "interim LRV". For the reconnaissance role the Army requires a heavier weapon to enable vehicle self-defence (and suppression of enemy reconnaissance units) when deployed in advance of allied forces. In 2018, Oshkosh presented a possible configuration including a Kongsberg PROTECTOR Remote Weapon System (RWS) mounting an XM 914 30mm chain gun and a coaxial 7.62mm machine gun. In September 2019, Oshkosh presented an upgraded reconnaissance configuration featuring a Kongsberg lightweight LW30 RWS with an M230 LF 30mm cannon and a JAVELIN Anti-Tank missile, and the roof-mounted FLIR Systems BLACK HORNET Vehicle Reconnaissance System which allows soldiers to deploy a small UAV while remaining inside the vehicle.

US Army Light Reconnaissance Vehicle

Aside from the accommodation limit of five soldiers (including one in the weapons turret) rather than the six soldiers originally required by the Army, the JLTV has much to recommend itself for the scout and liaison role. Fuel economy and range significantly surpass the capabilities of today's reconnaissance HUMVEEs. The TAK-4i Suspension provides for a significantly smoother ride on broken ground, which translates not only to greater occupant comfort but also to reduced vehicle stress and damage; it also permits off road speeds 70% higher than those of the HUMVEE, enabling faster approach or retreat from a target zone. The engine can utilise almost any combustible substance, from jet fuel to Diesel to alcohol, providing great flexibility when operating beyond friendly supply lines. Even more importantly for the scout and liaison role, the JLTV is designed from the bottom up to fully integrate into tactical C4ISR networks. Finally, utilising the JLTV will simplify battlefield and garrison logistics support.

Author

Sidney E. Dean is President of Transatlantic Euro-American Multimedia LLC. and a regular contributor to ESD.

Photo: UK MoD / Sergeant Andy Reddy RLC

A FOXHOUND Light Protection Protected Vehicle is pictured at Camp Bastion, Helmand, Afghanistan.

Marine Corps Polaris MRZR

While the Army is relying on the 6,400 kg, heavily armed JLTV as the primary reconnaissance vehicle for light formations, the US Marine Corps (USMC) has (since 2016) procured 244 units of the 3.6-metre-long, 950 kg Polaris MRZR-4D for its reconnaissance forces. The MRZR can carry up to 6 soldiers or a 680 kg payload. The open-framed ultralight vehicle comes with an optional roll-cage and sun-cover, but provides no option for a cab or armour. On the other hand, it offers impressive off-road agility. The transmission switches between 4-wheel drive for off-road operations and 2-wheel drive for on-road travel. At circa 450 km, the Diesel variant provides 80% greater range than the gasoline variant of the MRZR.

OCELOT/FOXHOUND

The OCELOT protected patrol vehicle is designed and produced in the UK by Ricardo plc and Force Protection Europe; it entered service with the British army in 2012 under the designation FOXHOUND. The 400 vehicles are utilised for various missions including as a scout and liaison vehicle, and have seen extensive deployment in Afghanistan. The OCELOT seats six (2+4) in the patrol and command missions, and four (2+2) in the reconnaissance role. According to the British MoD, "being lighter and smaller than other protected vehicles (...), FOXHOUND brings a whole new capability to the Army and is ideal for soldiers operating in mentoring and partnering roles [because] its size and agility allows troops to carry out a wide range of tasks in environments that may restrict larger, heavier vehicles [including] urban areas."
The OCELOT is 5.3 metres long and has a curb weight of 5,500 kg. It has a range of 600 km and a road speed of 110 km/h. Off road capabilities include a fording depth of 100 centimetres, approach and departure angles of 45 degrees, and a gradient/side slope of 60%. The vehicle has a Steyr-Daimler-Puch six cylinder tur-

Photo: Graeme Main/MOD

The interior of a FOXHOUND Light Protected Patrol Vehicle

Photo: USMC

US Marines drive the Polaris RZR tactical vehicles through a fording pit during an all-terrain vehicle course at Marine Corps Base Camp Lejeune, North Carolina.

bocharged Diesel engine and a six-speed automatic transmission. The manufacturer states that the OCELOT can operate at temperatures between -32 and +54 degrees Celsius. The vehicle can be internally transported by C-130 or sling loaded beneath a CH-47.

The OCELOT is designed with a mine-resistant v-shaped hull and blast-protection technology. The hull is modular. The protected crew pod can be dismounted, enabling multiple potential configurations for different mission types. The vehicle provides STANAG level 2 mine blast, kinetic energy and ballistic protection as standard features (the British MoD describes these capabilities as unprecedented in a vehicle this size). EFP (explosive formed penetrator) and RPG protection are available as an add-on kit. Thermal imaging night vision cameras provide 360 situational awareness.

JACKAL

The British Army and Marine Corps also operate the 5.4-metre-long JACKAL 4x4 armoured reconnaissance vehicle, in three variants: JACKAL (200 units), JACKAL 2 (110), and JACKAL 2A (130). Built in the UK by SupaCat and Babcock, the vehicle is primarily utilised for reconnaissance in depth as well as for rapid assault and fire support missions. The JACKAL family are a high mobility weapons platform. The air suspension systems permit a variable ground clearance ranging from 18 to 48 centimetres. A unique airbag suspension system permits rapid movement across varying terrain. Maximum speed is 80 km/h. The unsupported mission range is 800 km. The first JACKALs entered service in late 2007, deploying to Afghanistan the following year to serve with the commando brigade's patrol troop and with the 16th Air Assault Brigade's pathfinder troop. The JACKAL 2 variant entered service in 2009, followed by the 2A which has now become the build standard. The major differences between the variants are: the JACKAL 2 is heavier than the first generation (curb weight: 5,500 kg), resulting from a heavier chassis and additional side armour to increase crew protection against roadside explosions and mines; the gun ring has been moved forward to provide a 360-degree field of fire; the single "jockey seat" provided for the main gunner was replaced with two blast-protected seats, increasing the crew from three to four. The 2A variant is based on the JACKAL 2, but features enhanced blast protection.

The armament ring can mount a single main weapon; depending on mission parameters the crew can choose between a 7.62 or 12.7mm machine gun or an automatic grenade launcher as the main weapon, supported by a 7.62mm weapon at the vehicle commander's station (next to the driver).

SupaCat LRV 400

In 2015 Supacat introduced a smaller option, the LRV (Light Reconnaissance Vehicle) available in a 4x4 or a 6x6 configuration. The LRV is intended to fill the niche between heavier reconnaissance vehicles such as the Jackal and ultralight recon vehicles such as dune buggies or quads. The 4x4 has a curb weight of 2,500 kg and a length of 4.64 metres. It can be transported (fully loaded and equipped) inside a CH-47 and be ready to operate immediately upon landing. Modular configuration options include an open vehicle with roll bars or an enclosed crew cabin. Performance parameters include a top road speed of 160 km/h and a range of 800 km. Off road performance includes a 32 centimetre ground clearance, a 75 centimetre fording capacity, and the ability to handle a 60% slope and a 40 degree gradient. The LRV features a 3.2 litre Diesel engine and a permanent four-wheel drive. Options listed by the manufacturer include Hutchinson beadlock run-flat tires, self-recovery winch, remote weapons station and additional weapon mounts, smoke grenade launchers, IR lights, lightweight ballistic armour and ballistic crew seats, RHD or LHD, on board water boiler, Pinnacle compass, canvas roof and side screens, forward and rear facing IR cameras, detachable polycarbonate windscreen, 12V and 24V electrics, NATO tow hook. A variety of

Photo: UK MoD / Sgt Jamie Peters RLC

Pictured are tracer rounds from the .50 calibre Heavy Machine Gun mounted on a JACKAL, streaking across the sky as soldier's fire during a night exercise.

communications and weapons systems can be integrated. The vehicle accommodates up to four soldiers and an operational payload of 1,700 kg.

LGS FENNEK

The LGS FENNEK (LGS = Leichter Geschützter Spähwagen, Light Protected Reconnaissance Vehicle) vehicle was developed jointly by Krauss-Maffei Wegmann and Dutch Defense Vehicle Systems. A total of 632 were produced in the 2003-2015 timeframe. The German army operates 220 FENNEKs. Approximately 80% of these constitute the primary asset of the army's reconnaissance force; they are expected to be the mainstay of that force for the foreseeable future. Small numbers are also utilised as artillery spotters and forward air controllers for ground attack aircraft (Joint Fire Support Team role), or as engineering command/reconnaissance vehicles. The Netherlands' army operates 410 FENNEKs; approximately half of these are dedicated to reconnaissance.

The 5.6-metre-long vehicle has a low profile of only 1.78 metres when the sensor mast is retracted, minimising the risk of detection by opposing forces. The FENNEK also features very low infrared, radar and acoustic signatures to minimise detection. The all-welded steel hull provides protection against small arms, shrapnel, and anti-personnel mines. The air conditioned cabin is NBC protected. A roof mounted machine gun or grenade machine gun provides self defence.

The 10.3-tonne vehicle has a range of nearly 1,000 km. The three-person crew – commander, driver and sensor operator – can stay in the field for five days. According to the German army, the FENNEK can be deployed in almost any terrain. The Deutz Diesel engine can accelerate the FENNEK to 115 kph on flat terrain. The crew can alternate between two- and four-wheel drive. Likewise, tyre inflation can be adjusted to match terrain requirements.

Reconnaissance missions can include detection and monitoring of enemy troop movements and surveillance of towns or larger stretches of terrain. The state-of-the-art reconnaissance sensors are mounted on a telescoping mast; they include a laser range finder, a CCD-daylight camera and a thermal camera. When deployed, the mast extends 3.3 metres above the vehicle roof. Target coordinates can be fed into the tactical data network in near real time, and transmitted to artillery or aircraft for immediate engagement. The sensor head can be dismounted from the vehicle and set up on a tripod at a distance up to 40 metres from the vehicle; sensor data can be monitored from within the cabin. The FENNEK can also carry ALADIN miniature reconnaissance UAVs and a remote controlled mobile sensor system (MoSeS) as additional sensors.

Photo: SupaCat

SUPACAT LRV 400

MOWAG EAGLE V

The MOWAG EAGLE vehicle family (now General Dynamics European Land Systems) is currently being produced in its fifth generation (EAGLE V, introduced in 2010); the previous EAGLE IV variant is also still in production. The EAGLE is available in both 4x4 and 6x6 configurations. The 4x4 variant is 5.4 metres long with a weight of 7,000 kg. It has a range of 700 km and a road speed of 110 kph. The EAGLE V 4x4 has a payload capacity of 3.3 tonnes, which exceeds the capacity of the IV. It comes with permanent four-wheel drive, and is powered by a powerful 6.7 litre Diesel engine with 250 horsepower.

Photo: German MoD

A German Army FENNECK conducting live-fire training.

Photo: via author

A German Army MOWAG EAGLE V.

Photo: KMW

DINGO 2 Reconnaissance vehicle with machine gun mount

Both the EAGLE IV and V feature a double v-shaped hull and display a higher level of blast- and fragmentation protection than most vehicles of equivalent weight or size (STANAG 3 for ballistic protection and STANAG 2a for mine protection). Modular add-on packages can enhance threat specific protection against mines, IEDs, or RPGs. The vehicle is typically armed with two roof-mounted machine guns including one 12.7mm heavy MG on an optional RWS.

The EAGLE can be optimised for various mission types including command & liaison vehicle and reconnaissance vehicle. The EAGLE V fits accommodates soldiers and a wide variety of mission specific equipment which can include weapon stations, an electronic warfare system, or additional communications gear. The digital dashboard display presents all relevant vehicle data as well as input from externally mounted electronic and camera sensors.

The MOWAG EAGLE is in service with the armed forces of Denmark, Germany and Switzerland. The Swiss inventory consists mostly of older vehicles, including 329 EAGLE I and II variants used as reconnaissance vehicles. Denmark has relegated its 30 EAGLE I reconnaissance vehicles to storage, but operates circa 90 EAGLE IV 4x4 as reconnaissance and patrol vehicles; during 2018-2019 Copenhagen took possession of 36 new EAGLE Vs, a portion of which will be delegated to reconnaissance duties. The largest contingent is found with the German army, which has acquired 671 units (EAGLE IV and EAGLE V variants) since 2008; they are utilised as reconnaissance and patrol vehicles and as field ambulances. The Eagle 4x4 is also considered a contender for the Polish army's Pegaz programme which aims to acquire a fleet of vehicles for the special operations forces.

DINGO 2

The reconnaissance variant of KMW's DINGO 2 is equipped with a mast-mounted ground surveillance radar (GSR) system. The radar detects and identifies moving vehicles and infantry within a 40 km radius, providing highly accurate target acquisition, identification, classification, and tracking. Alternately the telescoping mast can be equipped with optoelectronic sensors including daylight and infrared cameras.

The DINGO 2 family also includes a specialised NBC reconnaissance variant equipped for rapid identification of chemical and nuclear agents. The equipment suite in-

Photo: Renault Trucks Defense / Arquus

A SHERPA Scout

Photo: Arquus

The armed SCARABEE scout car

cludes: a meteorological station; a remote-controlled system for soil and air sampling; a sampling tool for detection of chemical agents; a multi-sensor-system (MSS) radiological detection system; a mass spectrometer; an online analysis system for sample identification; a digital data transmission system for rapid reporting of results.

The reconnaissance variants of the DINGO feature the same all-terrain handling characteristics as the patrol vehicle version, but have a crew of only four. The operational range exceeds 1,000 km.

SHERPA Scout

The SHERPA Light vehicle family originally developed by Renault is currently marketed by Arquus. The Scout variant of the SHERPA Light can be deployed for scouting, surveillance, patrol, convoy escort, and for command & liaison missions. The 5.4-metre-long vehicle has a base weight of 7.9 tonnes; it achieves 110 kph top speed and a mission range of 1,000 km. The all-terrain capable SHERPA has a ground clearance of 60 centimetres, a fording capability of 1.5 meters, and the capacity to traverse a 90 centimetre trench. The vehicle is available in armoured and unarmoured configurations, with additional add-on armour kits and ballistic windows available. The Scout variant can be equipped with either an open turret or remote weapon station mounting a single gun up to calibre 12.7mm. It can optionally be equipped with the mast-mounted Thales Margot surveillance system. The SHERPA can be airlifted by C-130 or A400 aircraft. The maximum crew capacity is five soldiers. The SHERPA Light is currently operated by ten nations including France, and remains in production.

Arquus SCARABEE

Volvo's French subsidiary Arquus unveiled the prototype of the SCARABEE armoured car at Eurosatory 2018, and presented the vehicle to the general public during the Paris Airshow in June 2019. The futuristic looking SCARABEE is billed as a light armoured 4x4 vehicle for reconnaissance, scouting and support, both at the front lines and behind enemy lines.

The hybrid propulsion system includes a 300 horsepower Diesel engine and a 103 horsepower electric engine, both mounted in the rear; a large battery is located between the double floorboards. The electric engine can be employed when a silent approach to target is required, or when on-board systems must continue to function during prolonged overwatch missions. Both engines can be used simultaneously to provide a "boost mode" when very high speed is required.

The driver – described as the "pilot" in Arquus documents – is seated forward of the remaining three crew members, providing him a 270-degree sightline. The remaining crew operate surveillance sensors and weapons. Armament options include a multipurpose HORNET RWS which can be equipped with machine guns, an Orbital ATK 230LF 30mm chaingun, MMS or MILAN missiles, or anti-drone weapons. Modular vehicle armour can be adjusted to meet mission requirements.

The highly agile vehicle operates with high wheel clearance (50 centimetres) for off-road missions, and at normal clearance for on-road or urban manoeuvres. The air intake for the engine is located on the roof to protect the engine from water or mud during fording manoeuvres. An independent rear drive provides a very tight turning radius, and even allows the vehicle to move sideways ("crab mode").

The SCARABEE can be airlifted inside a C-130, A400M or CH-53 with the crew inside the vehicle, ensuring it is mission ready within 15 minutes of landing.

While development of the SCARABEE officially began in 2017, the vehicle bears very close resemblance to the Panhard CRAB concept vehicle unveiled at Eurosatory 2012 as an armoured scout car (in 2018, Panhard became a part of Arquus). In June 2019 Jane's cited Arquus officials stating that the SCARABEE is expected to be production ready by 2022. ■

Miniaturisation – Not Only About Technology

Manuela Tudosia

Miniaturisation is often associated with mini- and micro- Unmanned Aerial Systems (UAS). In turn, this can be perceived as dangerous if one considers the scenario of rogue actors using mini-UAS carrying nano-explosive payloads. Debates around the ethics of nanotechnologies are also popular.

To see a World in a Grain of Sand" (…) "Hold Infinity in the palm of your hand, And Eternity in an hour", writes William Blake in his "Auguries of Innocence". The dream of a poet meets, perhaps, the ideal of the science of miniaturisation. While such aspects should not be disregarded, in reality, miniaturisation is a field of continuing scientific innovation with numerous positive consequences on defence and civilian applications. In defence, advances in this field were often triggered by practical and evolving needs of the warfighter when confronted with various operational environments.

As defence systems have grown ever more complex, the reduced size and weight of system components became a must alongside the need for low power, faster and more enduring solutions. Miniaturisation made possible the addition of new functionalities in smaller systems, bringing key operational advantages, such as better communications, better precision and targeting, or better navigation. Improved resistance to known effects in military applications could also be obtained thanks to miniaturisation. For example, the small size of certain military-grade sensors can mean better protection of essential electronic components from vibration and shock. Likewise, smaller and lighter can also mean less power consumption.

As science progresses, more solutions become available thanks to research in nanotechnology and miniaturisation. However, many challenges are yet to be overcome - both technical and cost related - which opens a wide set of opportunities in the years to come.

Photo: MBDA / Adrien Daste

The PESCO-financed LynkEUs project seeks to define an initial operational concept for a European BLOS capability.

The Need for Miniaturisation

An obvious example where the need for reduced size and weight, combined with low power consumption, is the dismounted soldier. Miniaturisation of sensors, which often also comes with less power consumption, can increase situational awareness and survivability without increasing the burden on the soldier. In the field of CBRN protection, high on the agenda today, the use of miniaturised biosensors is being studied more and more. Nanopore sequencing, for instance, could offer interesting possibilities for bio-detection on clothes. More generally, wearable sensors for physiological monitoring and other environmental sensors are beneficial for early warning purposes. Miniaturisation allows for an entire array of sensors on a soldier's equipment in order to collect intelligence on their health status and the surrounding operational area. If connected to the system's architecture, the network of sensors is able to provide valuable real-time information to the commander.

Research in nanotechnology with the aim of advancing protection and survivability is the focus of the Institute for Soldier Nanotechnologies (ISN), a partnership between the Massachusetts Institute of Technology (MIT), the US Army and industry. The ISN Strategic Research Areas are derived from armed forces' operational needs and challenges, like development of lightweight and stronger materials for protection against mechanical damage (blast waves, vibrations, etc.), secure communications and protection against electromagnetic pulse and spoofing technologies, or nano-optoelectronic capabilities for portable power, communications, signal processing and detection.

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.

Photo: Airbus Defense and Space

DARPA awarded a contract to Airbus Defense and Space to develop a satellite bus in support of the BLACKJACK programme.

Power storage and battery life are recognised needs, not only for the dismounted soldier, but also for a variety of other defence applications, including certain munitions. In certain cases, batteries cannot be replaced since they are part of a compact system that cannot be dismantled without compromising its safety and performance. This can have important implications on life cycle costs and stockpile management.

Carbon nanotubes have made the availability of lighter weight batteries possible, also with much higher power storage when using a coating process. For example, French NAWA Technologies developed a new generation of batteries through a "unique coating for these nanotubes" resulting in batteries that can offer five times higher power density than existing ultracapacitors.

Last, but certainly not least in the list of examples, is the immense impact that miniaturisation of GPS receivers and inertial instruments - commonly used to augment GNSS signals – have had on Guidance, Navigation and Control (GNC). A wider range of vehicles can now be equipped with GNC functionalities thanks to the development of micro-electro-mechanical (MEMS) inertial sensors that can address the size, weight, power and cost (SWaP-C) challenge. MEMS have been available on the market for several years now, many of them at low cost and with increasingly improved performance. In defence, MEMS Inertial Measurement Units (IMU) play key roles in Precision Guided Munitions and missiles, autonomous vehicles and robotics, or communications. Compared to MEMS, it took more time to achieve, at a lower cost, miniaturisation and manufacturing of Fibre Optic Gyroscopes (FOGs), but progress in optical technology and photonics seems to offer solutions on this front.

It is also self-evident that all the progress made in miniaturisation has a wide-range of civilian applications, benefitting the whole of society. For example, low-cost MEMS have been used for some time now in vehicle safety systems or mobile phones. Besides navigation, increasingly performant MEMS and FOG sensors are used in civilian communications, the energy sector, or precision agriculture.

Challenges Still Ahead

Miniaturisation is a constant and evolving need across the spectrum of defence and civilian applications. Examples include addressing the GNSS denied environment or the Radio Frequency spectrum in a more optimal manner, developing smart textiles, or the transversal need for ever smaller sensors and electronics.

Research conducted into past and current DARPA Broad Agency Announcements and related SBIR or STTR programme announcements offer many examples where industry and academia are invited to take on the challenges involving miniaturisation. DARPA also has a dedicated Microsystems Technology Office whose "core mission is to develop high-performance intelligent microsystems and next-generation components". Focus areas are Command, Control, Communications, Computing, Intelligence, Surveillance, and Reconnaissance (C4ISR), Electronic Warfare (EW), and Directed Energy (DE).

Besides the technology aspect, it is important to place miniaturisation in the context of SWaP-C, and the latter in the context of future conflict. It is not only about technology. It is also about understanding the characteristics of the future conflict across all operational domains.

In a 2019 interview with Deloitte, Dr. Fred Kennedy, Director of DARPA Tactical Technology Office, explained the rationale of DARPA's Blackjack project, a space-based internet that "will be enabled by an interconnected network of small, inexpensive satellites in low earth orbit." In this context, he also explained the interest of miniaturisation from a strategic

Photo: DARPA

Under the Blackjack programme, DARPA aims to develop a global high-speed network in low Earth orbit.

point of view: "The future will not be defined by major assets, because anything we can't afford to lose in battle cannot be the future of battle. The future will be about expendable assets, networked together in real time to form a hyperconnected information environment. So, the goal is to be agile enough to dominate the next war, or better yet, to deter the next war."

The 2020 British MoD Defence Science and Technology Strategy also highlights the opportunities offered by the Small Satellite Revolution. Beyond the space domain and satellites, the potential of emerging and disruptive technologies has been highlighted in several national, NATO and EU official documents, including the recent UK Defence Command Paper. Very often, miniaturisation is at the core of emerging technological developments, for example, AI, quantum, hypersonics or new materials.

What is in it for European SMEs?

Increased investment in emerging technologies is a clear trend appearing from the analysis of recent national defence reviews and military programming laws. As previously mentioned, miniaturisation is an integral part of emerging technologies, enabling disruptive effects. Small and Medium-Size Enterprises (SMEs) are often described as "fast" and "agile", both characteristics that seem to be highly valued in the context of future warfare. They certainly have a role to play in this context.

At the EU level in the past two years, the European Defence Industrial Development Programme (EDIDP) issued dedicated calls focused on innovative defence products, as well as SME calls stressing the need for products, solutions and technologies that can create a disruptive effect.

The OPTISSE project, a consortium of SMEs from five EU countries, took up the challenge of miniaturisation and was selected. The project "will perform a feasibility study and a preliminary design of innovative technologies for a cost-effective high performance Earth Observation payload for small satellites. The technologies include a multispectral and miniaturised optical imager with very high resolution, image processing algorithms, a satellite subsystem for features tracking and a satellite sub-system for high-rate data transmission."

The publication of new calls for proposals is expected in the coming months under the European Defence Fund (EDF). Disruptive technologies and SMEs will probably continue to be in the focus during the whole EDF implementation period. Attempting miniaturisation can be a promising investment not only for those SMEs who target the SME-focused calls, but also for those who aim to be part of consortia addressing specifically defined challenges. Information available in the EU 2020 Coordinated Annual Review on Defence (CARD) Report already provides hints regarding priority areas where miniaturisation and nanotechnology can make a huge difference, like new sensor technologies, emerging materials and energy efficient propulsion systems, as well as unmanned systems and robotics.

Despite the somewhat demoralising length of the COVID crisis, there is no better time than today for EU SMEs to take a "quantum leap". ■

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