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EU Put to the Test



What had long been regarded as inconceivable became a reality on the morning of 23 June 2016. The British voted to leave the European Union. The majority that voted for "Brexit", at just over 52 percent, was slim, and a great deal smaller than the 67 percent who voted to stay in the then EEC in 1975, but ignoring the majority vote is impossible. The rules of the democratic game are to be respected, and anyone who tries to bend them is undermining the basic principles of political order which make our continent what it is. Those who now bemoan the fact that the "Oldies" overrode the interests of the "Young Ones", whose future, in the final analysis, is really at stake, or mutter about the people who led the Brexit campaign being prompted by dumb resentment, without being in the least clear about the consequences, need to be aware what pattern of thought they are in fact serving here. Up to now, it has been left to critics of democracy from the far left and the far right to draw the distorted image of the immature voter, whose blinkered vision and lack of understanding made it impossible to see where their real interests lay, and so make a rational decision. But people who take that line are calling into question the legitimacy of voting altogether, and leave matters in the hands of autocratic so-called or self-styled "experts". So what prompted the majority of voters to vote to leave? One of the more basic answers can be found from the main points underlying the Brexit campaign. There are three issues which particularly stand out. One criticism was the subtle disempowering of the British Parliament, which, with regard to legislation, was seen as largely rubber-stamping what had already been decided in Brussels. This argument is not to be understood as the notion that the British were clinging in some eccentric manner to their national sovereignty. The view that the Brussels institutions are drawing the reins of power more and more into their own hands without being subject to any real democratic restraint is widespread in Europe. All appeals to follow the subsidiary principle, and only to impose rules on Europe in those contexts in which the nations themselves were overstretched, came to nothing. The dynamics of the inertia of EU bureaucracy in pursuing, sometimes with more enthusiasm and sometimes less, a vision of a European Federal State, leave no room for questions as to whether centralisation is necessarily efficient, or whether this is something that the citizens of the Member States really want at all.

The second main argument of the Brexit campaigners was less about a "democratic sense of citizenship" than of material self-interest. Despite all the exception rulings granted, the United Kingdom is among the net contribution payers in the EU. This money, it was suggested, could be put to better use invested in the social structures back home. What was sidelined here was the fact that an involvement in the common European market in line with the Norwegian model would not be for free. Should the UK want to pursue this after leaving, it would have to pay for it, but without having a say in the use of the resources as in the past. What may have swung the vote, however, was the sense of gaining independence from European rules and regulations when it comes to immigration policy. The EU has not proved its worth in getting a grip on the ongoing refugee crisis – and that is not a view held just by the British alone. If things had been otherwise, the referendum might well have gone the other way. Regardless of whether the Brexit vote actually leads to Brexit, the questions which the British are asking themselves are starting to come onto Orders of Business in other European states as well. The campaign for the "Nexit" referendum in the Netherlands is already well under way. There would be no cause for concern about the EU in this context if it could present itself as a success story – something it has not done since the Maastricht Treaty – which the greater mass of the citizens could experience for themselves. But this is not the case. For broad sections of the populations of almost all EU states, the past two decades have been characterised by stagnation, a sense of their welfare being constantly under threat, of growing inequality, of cuts in social services, and increasing pressure to perform. For them, the welfare promises of European integration have not been fulfilled. On a global comparison, too, Europe is seen as a continent plagued by weak growth, unable to find its way out of the financial and currency crisis, and running into a demographic crisis with both eyes wide open. But is the EU really to blame? Or has it perhaps actually prevented something worse happening? This is something to think about, and an answer has to be found, if, following the Brexit referendum, we do not simply want to shrug our shoulders and turn to the next item on the agenda.

Peter Bossdorf

Strategic Airlift



The future fleet of European aircraft should – at least – enable the rapid deployment of VJTF and NRF forces and EU Battlegroups. [Page 32](#)

Defence Modernisation in Poland



In recent years Poland has increasingly invested in its armed forces. A technical modernisation programme for the 2013–2022 period was launched in 2012. [Page 37](#)

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■ Next Generation Tiltrotor Combines Helicopter with Aircraft

(df) The Bell V-280 Valor full-size mockup made its international debut at Farnborough. This helicopter shows a glimpse of the future, the company said. With the unique capability of a helicopter combined with flying like an airplane the range of the V-280 Valor will be unmatched. "The Bell

(Graphic: Diehl Defence)



(Graphic: Bell Helicopter)



V-280 Valor provides warfighters strategic options, operational reach, tactical agility and overmatch at the point of decision," the company statement said. "The Bell V-280 Valor design supports ground manoeuvre and is purpose built for the squad plus enablers. Safe and survivable, the design features integrated cabin armour, fly-by-wire component redundancy, state of the art countermeasures and performance. Bell Helicopter's design to build technology used on the V-280 Valor significantly enhances manufacturing, assembly, and sustainability, while greatly reducing the total cost of ownership." With more than twice the speed and range of current helicopter platforms, the Bell V-280 Valor provides access to long distance targets as well as engagement capability upon reaching them. In May 2016 Bell Helicopter completed successful V-280 Valor wing and fuselage mating. So this next generation tiltrotor is progressing and on track for the first flight, which is scheduled for 2017.

■ Guided Missiles for the German TIGER Attack Helicopter

(df) Diehl Defence is offering the German customer the 70 mm GILA (Guided Intelligent Light Armament) guided missile for the TIGER support helicopter. The procurement could close the capability gap for guided ammunition, a capability a real attack helicopter should of course have nowadays. But Germany is still in the evaluation process, and has been for over three years now, with no published timetable for procurement so far. GILA is based on the Guided Advanced Tactical Rocket (GATR) produced by the Israeli company Elbit. "The proven technology of the Semi-

Active Laser (SAL) seeker detecting laser radiation reflected from the target is used for engagement," the company said. "In case the helicopter has no laser illuminator on board, this task can be performed either by ground troops, e.g. the Joint Fire Support Teams of the ISR Army Corps or by NATO aerial vehicles, for example EUROFIGHTER TYPHOON or unmanned aerial systems." GILA could be fired from the TIGER's current 70 mm launcher without additional modifications. It is an entirely developed product. Its qualification and integration could begin immediately.

■ Successful Test of FURY

(df) The FURY lightweight precision guided glide weapon has been successfully tested from the Shadow Tactical Unmanned Aircraft System (TUAS) against static vehicle targets, Thales and Textron Systems Weapon and Sensor Systems announced. The tests took place at the US Army's Yuma Proving Ground in Arizona. During the testing, FURY was released from 8,000 feet altitude, conducted a Global Positioning

(Graphic: Textron Systems)



System (GPS) guided fly-out manoeuvre and transitioned to the Semi-Active Laser (SAL) guided terminal engagement, directly striking a static vehicle target. "We are pleased with the test results and development progress of the FURY weapon system – the latest test proved the GPS and SAL guidance capability from 8,000 feet and was a significant incremental step in the weapon's development," says Weapon and Sensor Systems Senior Vice President and General Manager Brian Sinkiewicz. The FURY weapon uses a common interface for rapid integration on multiple manned and unmanned aircraft systems. The weapon's tri-mode fuzing – impact, height of burst and delay – further enables a single FURY

to address a broad target set, ranging from static and moving light armoured vehicles to small boats and personnel. The FURY precision weapon is guided by a GPS-aided inertial navigation unit system with a semi-active laser seeker terminal guidance capability. This enables the weapon to engage both stationary and moving targets within one metre accuracy, or fly to specific target coordinates.

■ Advanced Radar Detection System for the REAPER

(df) General Atomics Aeronautical Systems (GA ASI) and Raytheon Deutschland announced that they will integrate the Advanced Radar Detection System (ARDS) with a GA-ASI PREDATOR B/MQ-9 REAPER. A scalable Electronic Support Measure

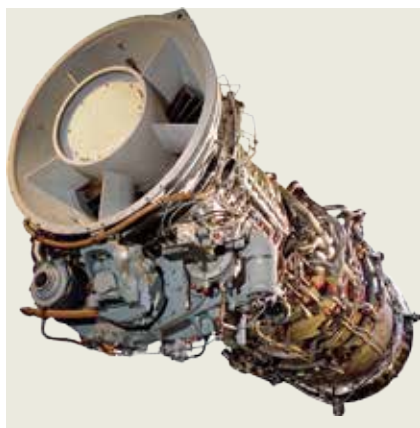
(Photo: GA ASI)



(ESM) system for passive radar monitoring, ARDS is designed and developed by Raytheon Deutschland on the basis of modules that are produced in Spain and in the UK. The European-made ARDS provides passive, wide-area Electronic Intelligence (ELINT) over land and sea and enables high-fidelity detection and direction-finding of RF emitters. The ARDS will be integrated into a standard pod that will be mounted on the centerline hard point of PREDATOR B. "PREDATOR B is the ideal platform for our ARDS as it deploys the ELINT capability with significantly greater endurance at much lower cost per flight hour compared with other platforms," said Andreas Radermacher, Managing Director, Raytheon Deutschland GmbH. A combined GA-ASI and Raytheon team is currently freezing the design of the integration hardware that will make this capability available to customers in 2018. The team plans to execute developmental and operational flight tests in the second half of 2017.

■ Turkish Corvette Launched

(df) The Turkish Navy's third MILGEM multi-purpose corvette TCG BURGAZADAWAS just launched at the Istanbul Naval Shipyard; a keel laying ceremony was also held for sister MILGEM ship TCG KINALIADA. Of special interest is the propulsion system used for these corvettes: a GE LM2500 gas



(Photo: GE)

turbine-based propulsion system produced by GE's Marine Solutions. The propulsion systems for TCG BURGAZADA (F-513) are the same as its sister's, TCG HEYBELIADA (F-511) and TCG BÜYÜKADA (F-512), consisting of an LM2500 gas turbine in a combined diesel and gas turbine configuration with two diesel engines. Total propulsion power is 31,000 kilowatts, allowing the ships to reach maximum speeds in excess of 29 knots. The corvettes have an overall length of 99 metres with a displacement of 2,300 tons. Separately a fleet of 24 LM2500s operate aboard the Turkish Navy's BARBAROS- and GABYA-class frigates. Worldwide, the LM2500 gas turbine

is used by 34 international navies and in countless commercial marine and industrial applications.

■ Sense-And-Avoid Capability for HERON

(df) Israel Aerospace Industries (IAI) and Honeywell will jointly develop a Sense-And-Avoid (SAA) capability for IAI's HERON family of Unmanned Aerial Systems (UAS), the companies announced last week. Approved for funding from the Binational Industrial Research and Development (BIRD) Foundation, the system will be demonstrated for the first time on the HERON medium-altitude, long-endurance (MALE) UAS platform in 2018. The joint project will provide SAA capability on a HERON MALE. The system concept includes Honeywell-developed software, algorithms, hardware and the fusion of inputs from various sensors embedded in a single prototype box or Line-Replaceable Unit (LRU) and IAI's separation and collision avoidance manoeuvring logic and Ground Control Station (GCS) pilot interface. The LRU will be flight tested onboard IAI's HERON UAV for the first time through the BIRD programme. It will show improved situational awareness through the tracking of other nearby aircraft, allowing the UAS



(Photo: IAI)

to manoeuvre to avoid collisions and suggesting alternate flight manoeuvres. The demonstrations and flight tests planned for mid-2018 will be conducted on the IAI HERON 1 UAS. The development work will be executed in Albuquerque, Minneapolis and Redmond, as well as in Tel Aviv, Israel. Flight testing will take place in Israeli airspace. Both companies plan for the full sense-and-avoid solution to be integrated into the HERON family of MALE UAS. In the near term both companies expect that the work will set the foundation for safe operation and integration of unmanned aircraft in civilian airspace and will contribute to policies and procedures allowing for certification of avionics and platform systems.

■ Missile Testing with the British Eurofighter TYPHOON

(df) A UK Eurofighter TYPHOON has successfully completed an initial series of flight



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trials with the BRIMSTONE air-to-surface precision strike missile ahead of firing trials as part of a programme of work to integrate the weapon with the aircraft. The tests were conducted using UK TYPHOON Instrumented Production Aircraft (IPA) 6 and led by BAE Systems with the support of Eurofighter GmbH, MBDA and the UK's Ministry of Defence. This success was another major step to the initial firing trials, which are due to take place in the first quarter of 2017. It was the latest in a series of successful flight trials conducted by the Eurofighter partner companies in recent months as part of a major

programme of work to add capability to the TYPHOON. Central to the programme is the weapons integration work as part of the Phase 2 and Phase 3 Enhancement (P2E/P3E) packages, which will bring additional long range and precision strike capabilities to the TYPHOON. The integration of the deep strike MBDA STORM SHADOW missile, led by Leonardo, is also continuing. In addition, further firing trials have been completed with MBDA's METEOR beyond visual range air-to-air missile. The sixth in a series of firings, which were also completed last month by aircrew from Leonardo using IPA2 at the



(Photo: Eurofighter)

UK's Hebrides range, were intended to continue to expand the clearance envelope of the weapon, to validate the modelling and simulation that has been performed by the Eurofighter partner companies, Selex and MBDA.

■ Miniature Hit-to-Kill Missile

(df) Lockheed Martin's Miniature Hit-to-Kill (MHTK) missile was successfully launched in an engineering demonstration at White Sands Missile Range, New Mexico. The demonstration was part of the US Army's Aviation and Missile Research Development and Engineering Center's (AMRDEC) Extended Area Protection and Survivability (EAPS) programme. The MHTK interceptor is less than 72 cm in length and weighs about 2.2 kg at launch. It is designed to be small in size while retaining the range and lethality desired in a counter-RAM solution, with the reliability of other Lockheed Martin Hit-to-Kill interceptors. The MHTK uses Hit-to-Kill technology, which destroys threats through kinetic energy in body-to-body contact. The flight in this second test demonstrated the agility and aerodynamic capability of the MHTK missile, which is designed to defeat rocket, artillery and mortar (RAM) targets at ranges exceeding those of current and interim systems. This small missile complements other Lockheed Martin Hit-to-Kill interceptors by delivering close-range lethality for a layered defence system.



(Photo: Lockheed Martin)

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■ Latest Navigation Systems

(df) At SMM 2016 (6–9 September 2016 in Hamburg, Germany) Raytheon Anschütz will present a suite of the latest navigation systems, including the new SYNAPSIS NX INS and the next generation of smart heading and radar sensors. This new generation of navigation systems and sensors can be easily integrated into various system environments, no matter whether new-build or retrofit. The basis for all improvements of the modern bridge is integration, building on uniform and consistently developed system and operator concepts, modern network structures and harmonised data exchange. SYNAPSIS NX is not only type-approved according to the INS performance and test standards, it also introduces new applications such as SynGuard, a versatile display supporting situation analysis and decision making. SynGuard can be used for auto-



matic monitoring of the ship's surroundings, including the integration of camera systems, the identification and classification of other ships and objects, the definition and monitoring of certain alarmed or prohibited zones, or even the exchange of information

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with peers at sea or at shore. Raytheon Anschütz also exhibits the latest in heading and radar sensor technology at SMM – among others the new Standard 30 MF gyro compass and the NautoScan NX network radar. The next generation of these sensors is designed to support the sharing of data and status information via Ethernet.

■ Australian Defence Force PC-21 Completes First Flight

(wb) Pilatus Aircraft Ltd announced that the first of 49 PC-21 aircraft destined for the Australian Defence Force has successfully completed its initial production test flight at the factory in Stans, Switzerland. The flight took place only seven months after contract signature. Under a contract signed in December 2015 aimed at harmonising Australian Defence Force flight training across all three services – Army, Navy and Air Force – Pilatus will deliver a total of 49 PC-21, which will operate from four Royal Australian Air

Force bases. Pilatus will also supply significant elements of ground based training equipment and the in-service support capability. This first PC-21, registered as A54-001, will be handed over to the Royal Australian Air Force at East Sale in June 2017 after completion of testing and verification work in both Switzerland and Australia. Oscar J. Schwenk, Chairman of Pilatus, commented: "This initial flight of the first Australian PC-21, only seven months after contract signature, is a remarkable achievement and illustrates both the commitment of Pilatus and the hard work of all those involved in the project."

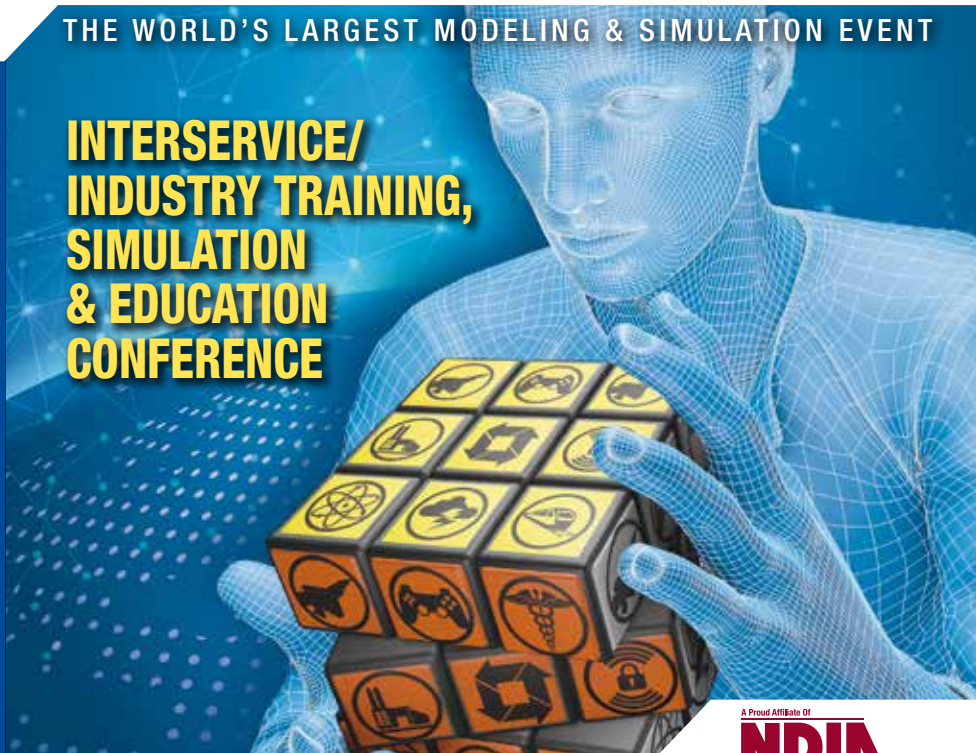


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NATO's Warsaw Summit: Re-Establishing Deterrence, Projecting Stability



Summits, which seem to be held ever more frequently these days, are often overblown with hype and media spin far ahead of actual concrete results. Yet, at a time when the international security environment is deteriorating rapidly with instability along all of NATO's borders to the east and to the south, we can no longer afford the luxury of unproductive summits.

Jamie Shea

This is a time when our publics judge the value of international organisations by their capacity to devise real answers to the challenges and their resolve to actually implement them. By this new, more demanding standard, the Summit the Alliance held in Warsaw last July was a milestone for NATO. Hopefully it will also re-stabilise Europe over time and help it to regain an internal cohesion that has been under severe strain since Russia annexed Crimea in March 2014 and ISIL reared its ugly head in Syria and Iraq. Whereas summits, even the successful ones, often tackle only one problem at a time, the Warsaw gathering took actions on a whole raft of challenges and vis-à-vis all the regions on Europe's periphery. Let us look at the key deliverables, and at some of the longer-term implications they raise.

Author



Dr Jamie Shea is the Deputy Assistant Secretary General, Emerging Security Challenges Division, NATO. The views expressed in this article are those of the author alone. They do not represent an official position of NATO.

Status of RAP Implementation

In the first place, NATO's leaders announced that the Readiness Action Plan, adopted at the previous NATO Summit in Wales in September 2014, has been substantially implemented. The security vacuum in central and eastern Europe exposed by a resurgent, revisionist Russia is being filled. Last year, NATO and its member states held over 300 exercises, many of which sent land, air and naval forces to Poland and the Baltic States to demonstrate NATO's solidarity and resolve. The NATO Response Force has been tripled in size to become a pool of 40,000 troops that can be configured in a number of ways to conduct land, air or naval operations, or as a spearhead or follow-on force. A very high readiness element (VJTF) can be deployed in as little as 48 hours to support local forces and establish a NATO foothold to cope with a breaking crisis. Subject to annual rotations in national command, it will be exercised regularly to ensure that it is certified both for speed and combat capability. To support the rapid staging of reinforcement forces, NATO is also establishing eight Force Integration Units in its eastern member states to provide the incoming forces with training logistics, pre-positioned equipment and host nation support. Eight capability packages will utilise NATO common funding for the strategic lift, command and control, logistics and communications to sustain this level of rapid reinforcement. The former German-Polish-Danish headquarters at Szczecin has been upgraded to a multinational headquarters north east to serve as a potential operational command centre, able to coordinate combined arms operations in a way that NATO has not had to do, at a level of a

division or above, since the end of the Cold War. Last autumn, the Trident Juncture exercise in Spain, Portugal and Italy, with over 30,000 participating troops, tested the Alliance's ability to a much broader spectrum of forces in a more intense and contested combat environment than NATO ever had to do in Bosnia, Libya, Kosovo or Afghanistan.

All of this costs money and as NATO realises that an assertive adventurist Russia in the east and jihadists able to acquire missiles and chemical weapons in the south are part of the "new normal", it will not be able to deter, let alone defend without increased defence budgets. The Wales Summit adopted a defence investment pledge to raise spending to 2% of GDP and to devote 20% of the budgets to modernisation and investment.

Increased Defence Spending

Understandably, and in the light of the hard-pressed European economies, this pledge was greeted with some scepticism at the time. Indeed, two years on, those countries meeting the 2% target have remained largely the same: United States, United Kingdom, Greece, Estonia and, more recently, Poland. But the pledge has proven to be a good forcing mechanism. Seventeen allies have increased defence spending since 2014 and collectively NATO's defence budgets have gone up for the first time since 2009. Nine have presented concrete plans to reach 2% within a decade and the number meeting the 20% investment target has increased from five to ten. Significantly, the Baltic States, Poland and Romania have recognised that their calls for NATO solidarity will be more compelling if they improve their own na-



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Up where we belong – NATO Secretary General Jens Stoltenberg (L, front), German Chancellor Angela Merkel (C, front) and French President Francois Hollande (R, front) watch the aerial display show during the opening ceremony of the NATO summit in Warsaw, Poland, on 8 July 2016. The NATO summit began with Polish President Andrzej Duda and NATO Secretary General Jens Stoltenberg officially greeting participants at the PGE National Stadium.

tional and reserve forces as the first line of defence. Germany has hovered around the 1-2% of GDP mark despite a buoyant economy, but has launched a new White Paper and an investment programme of €130 billion over 15 years that should enable the Bundeswehr to re-acquire some of its former heavy armour capability, as well as 7,000 extra soldiers immediately. France has also rescinded a cut of 11,000 soldiers although, in truth, this is due as much to the needs of internal security in the wake of the November 2015 terrorist attacks as to commitments in the Sahel or in the East. In the face of Russian intimidation in the form of snap exercises, provocative flight patterns and the militarisation of Crimea and Kaliningrad, NATO has held firm. It has also kept to its “Three Nos” commitment of 1997 to Russia, not to deploy substantial combat forces or massive infrastructure or nuclear weapons in the East in peacetime. The NATO forward presence will be persistent rather than permanent. Yet the original Readiness Action Plan, notwithstanding its rapid implementation, has not totally reassured the Eastern Allies who do not want to rely only on limited local forces and NATO’s ability to decide quickly in a crisis and move thousands of troops across hundreds of kilometres from Western to Eastern Europe. Here roads, railways, port and airfield availability will be a challenge even if NATO deploys in a permissive environment with no or limited Russian interdiction actions, now commonly referred to as anti-access, area-denial tactics (A2/AD).

RAP Supplementation

Responding to these anxieties, the Warsaw Summit decided to supplement the Readiness Action Plan with the deployment of four battalions in Poland and the

Baltic States. These will be rotational and multinational to emphasise that an attack against one is an attack against all, and will be led as framework nations by the United States, United Kingdom, Germany and Canada. The United States has contributed to a European Assurance Initiative with \$3.4 billion to pre-position the elements of a third armoured brigade in Europe. To enhance deterrence in the Black Sea region, Romania will host a multinational division south east and a brigade headquarters to host and exercise incoming NATO forces. It is also proposing a maritime multinational Black Sea task force to keep track of Russia’s more assertive military presence in this sea. The scope of this naval presence, together with the air defence picture in the region, will now be examined by NATO’s military authorities.

The NATO command structure will be reviewed to ensure that it is up to the task of coordinating a more complex structure of local forces, exercising forces, in-place battalions, rapid reaction forces and reinforcement follow-on forces on a longer notice to move. Articulating these forces in a way that does not leave large time gaps or major imbalances in the forces involved in these various echelons will be one of the key challenges if NATO should ever have to use force to repel an aggression. It is all about balancing light with heavy, rapid and slower, and in-place and reinforcement forces; all while acting in a way that dampens a conflict rather than escalates it.

Unfinished Business

The Warsaw decisions did not only complete work in progress but also initiated a great deal of follow-on work. Lurking in the background are some serious questions still in need of an answer.

The most urgent concerns air defence and airspace control, given Russia’s possession of a large number of modern fighters and bombers and NATO’s reliance hitherto on very modest air policing for the Baltic States. The Summit launched a Total Aviation System concept to better identify NATO’s future requirements. As a downpayment, the Summit endorsed work on a concept for a successor to the AWACs fleet around 2035, and in the margins letters of intent were signed for the development of maritime multi-mission aircraft and airborne electronic attack capabilities. In the missile defence area, NATO’s plans and capabilities are more advanced. The Summit declared the initial operational capability of NATO’s anti-ballistic missile defence system, based on a land-based site in Romania, United States AEGIS ships in the Mediterranean and a standing defence plan recently rehearsed by the control centre at Ramstein. The missile defence covers south east Europe and Turkey at this stage of its development; and whatever the accusations from Moscow, its range and height pose no threat to Russia’s nuclear deterrent. It is clearly designed to counter missile threats from states or non-state actors in the South.

Other pieces of unfinished business concern the need to generate more maritime forces for the NRF and to fill NATO’s four standing maritime groups; the A2/AD challenge, while not insuperable, will require more sustained military focus; and the commander of United States forces in Europe, General Ben Hodges, has called for a “military Schengen” to ensure that in a crisis the Alliance can move forces across Europe with no border formalities or obstacles. Before the Readiness Action Plan was promulgated in Wales, NATO’s strategic commands had identified 16 major capability priorities for operations, mainly concerning the enablers such as strategic lift, in-flight refuelling, jamming, suppression of air defences and precision-guided munitions. By the time of Warsaw, the priority requirements list had grown further, which is not a reflection of the lack of progress since Wales, but rather the fact that enhanced forward presence has thrown up new requirements, such as more ISR, anti-submarine warfare and artillery assets.

One key area, which is now commanding more attention, is cyber defence. Allies in Warsaw pledged to strengthen and enhance the cyber defences of their national critical infrastructures and networks. This Cyber Defence Pledge reflected the fact that cyber defence not only determines functionality in the virtual domain but also increasingly in the more conventional air, land, sea and space domains as well, and as



Photo: NATO

The Summit endorsed work on a concept for a successor to the AWACs fleet around 2035.

physical elements are linked to the Internet and made up of advanced electronics. Recognising this evolution, NATO also declared cyberspace as an operational domain. In doing so, it moved from an earlier focus on information assurance to a focus on protecting its military operations, including exercises and crisis management procedures, against cyber espionage and attacks. Cyber as a domain will also make it easier for NATO to overhaul its organisational framework to better manage resources, enhance military planning, identify needed skills and abilities and improve training and decision-making for cyber operations. This more coherent effort will need to be reflected in more intensive cyber defence exercises, based on more realistic scenarios in which a cyber attack is no longer a temporary nuisance but a real potential showstopper able to inflict lasting damage on equipment, communications and command and control. Allies will also be able to discuss a mechanism for how national cyber capabilities could be made available to the Alliance as a whole to assist an ally under attack or to support a NATO mission. This said, cyber like any other capability designed to produce a military effect, will only be used by NATO defensively and in line with the Alliance's defensive mandate. NATO will act in accordance with international law, and in a proportionate manner. Yet the more cyber becomes an inevitable and more decisive element of conflict, the more NATO allies have an interest in preventing cyberspace becoming an increasingly contentious, competitive and hostile domain, subject to none of the constraints we expect to see in dealing

with nuclear or chemical weapons, cluster bombs or landmines. So, in parallel with becoming a more cyber-enabled Alliance militarily, NATO will also need to support

voluntary international norms of responsible state behaviour and confidence-building measures in cyber space.

Finally, the Warsaw Summit spent as much time discussing security in the South as in the East. This not only reflects the immediate threats that the southern Allies are facing from uncontrolled migration across the Mediterranean as well as terrorism, organised crime and non-state actors like ISIL or Al Qaeda; it also testifies to a growing realisation that the disintegration of political order across Northern Africa and the Middle East leading to failed states and brutal sectarian conflicts are a major

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challenge to the Alliance overall. Just as the eastern NATO Allies cannot deal with Putin by themselves, so any possibility to stabilise the South requires the participation of all Allies and a more equitable burden-sharing. This is emerging in the form of Polish F-16s and Special Forces being sent to Iraq or trainers from Estonia to the Central African Republic as a quid pro quo for the US, Canadian and Western European forces currently exercising or deploying in Eastern Europe.

Security in the South

Of course, the challenges in the South are very different to those in the East and NATO is clearly far less in a leading role. Classical deterrence against an autocracy with



NATO Secretary General Jens Stoltenberg addressing the press on 8 July 2016 during the Warsaw Summit.

a conventional army does not work so effectively against jihadists intent on suicide, or religious and sectarian animosities or exploding demographics or the prolonged droughts due to climate change and water scarcities. This said, NATO's capabilities are not irrelevant either, provided they are deployed as part of a comprehensive approach and a realistic political-military strategy. The Warsaw Summit saw NATO begin to sketch out a more convincing strategy to project stability in the South, built around better partnerships with the countries in these regions and other international organizations.

In particular, the Alliance stepped up its assistance to the anti-ISIL coalition by agreeing to deploy some of its AWACs aircraft to the Eastern Mediterranean to provide more air surveillance. It agreed to move some of its defence capacity-building and



Photo: Wikimedia

The Summit declared the Initial Operational Capability (IOC) of NATO's anti-ballistic missile defence system including US Navy AEGIS ships in the Mediterranean. Shown here is USS PORTER (DDG-78), a DDG-51 Class (ARLEIGH BURKE) destroyer.

training activities from Jordan to Bagdad at the request of the Iraqi Government, and to help the nascent Libyan forces in a similar way once the new government of national accord in Tripoli has formulated detailed plans and provided a mandate. Building on the success of its anti-piracy and migration monitoring maritime missions in the Gulf of Aden and Aegean respectively – both in cooperation with the European Union – NATO also proposed to assist the Sophia mission of the EU in the Central Mediterranean. For instance, by providing ISR and maritime air support, tanker refuelling, logistics and help with forming the new Libyan coast guard and future navy. Greater use of the Alliance's two partnership fora in the Middle East and North Africa (Istanbul Cooperation Initiative and Mediterranean Dialogue) as well as more interaction with emerging organisations such as the Gulf Cooperation Council and the African Union, can help NATO build trust among the governments and security institutions of these regions, for what will inevitably be a long-term endeavour to help them re-establish control of their territories and borders. There will obviously be some exceptions here – the murderous régime of Assad in Syria being a case in point.

Geo-Strategic Challenges

As NATO moves from assessing the results of Warsaw to planning its next summit, further geo-strategic challenges already appear on the horizon.

One will be to bring NATO and the EU closer together in a joint approach to the East and the South (not forgetting the Western Balkans in the middle) where their respective assets are used in a truly coordinated way – and not just to symbolise the new cooperative spirit in Brussels but to achieve real results. This will be all the more important for a post-Brexit UK, which will need

a closer NATO-EU relationship to find its political role in Europe. The NATO-EU Joint Declaration signed in Warsaw was a good start and said all the right things; but it will only be as good as its implementation.

A second big challenge will be to keep NATO's multiple partners engaged in regular NATO business, as both contributors and legitimisers vis-à-vis the wider international community. It will be easy to do this in the case of Sweden and Finland because of shared preoccupations in the Baltic Sea and regarding an unpredictable Russian neighbour; but more distant partners like Australia and Japan or ones closer to home like Switzerland or Austria will not feel so involved in NATO's collective defence exertions. So how can the Alliance develop a broader and more normative security agenda that appeals to these partners too – and encourages them to come forward with their own initiatives as well as contributions? Yet, all this said, the greatest challenge will remain Russia. It will not be a partner, not even a potential one, for the Alliance for some time yet; but can the results of Warsaw at least encourage Russia to leave things there and work to stabilise its relationship with NATO through dialogue, transparency and risk reduction measures before Russia engages in further build-ups of its military forces? This will only increase tensions and inflict lasting damage on its fragile economy. The experience of the Soviet Union will hopefully remind Russians that – in peacetime at least – this has never produced happy results for them. In short, how can NATO translate its military reinforcement into a political lever to convince Russia of the merits of a return to the negotiating table?

After two years in which the European security environment has gone from bad to worse, it is time to put the bricks back into the wall and, if we cannot yet re-build, at least re-stabilise.

Viewpoint from Madrid



Nuria Fernández

Defence Continuity versus Political Uncertainty

On 26 June, Spain had its second parliamentary elections in six months. The first were held in December 2015 with an important novelty that marked the outcome: the arrival of two new parties, Ciudadanos (“Citizens”) and Podemos (“We can”). People showed their discontent in the polls, punishing the traditional parties – PP and PSOE – and rewarding the new ideas of the emerging parties. The Popular Party lost the absolute majority and the formation of the Government depended on respective agreements between the political parties. But these agreements did not come through and Spain had to cope with new elections. In the scope of the second edition, a significant part of the Spanish population came back to its original vote and PP and PSOE recovered positions, but neither achieved enough votes to govern alone. So, again, the parties are forced to reach agreements. But as this issue goes to print a few weeks after the election, the meetings continue and no governmental agreement is in place.

Be this as it may, however, these contradicting positions of the political parties involved are not expected to influence the national defence policy. Although it might appear different at a first glance, the electoral programmes of the four parties do not show significant divergences in the defence and security arena, just different priorities. The acting president, Mariano Rajoy, said during the visit of US President Barack Obama to our country on 11 July that one of his priorities was to continue the current foreign and security policy, at which point he highlighted the consensus that has always existed between PP and PSOE in this matter.

Indeed, the Popular and Socialist parties share many points in their respective defence programmes. Both of them point out the need of maintaining the international agreements with partners and allies, as well as contributing troops to missions abroad when required. They advocate the promotion of the Common European Defence Policy, a point also made by Ciudadanos. The priorities of Podemos in this matter are somewhat different. They defend a major strategic autonomy of Spain and Europe in NATO and ask for a public consultation to decide on the participation of the Armed Forces in international operations. This new political party devotes most of its defence programme to improvements for military staff, a very significant aspect for the other three parties, too. In this regard, we have to keep in mind that around 80% of the Spanish defence budget is dedicated to personnel costs.

Another important point included in the four programmes is the industrial policy. In this area, we have to emphasise the development of a multi-year funding law defended by PP, PSOE and Ciudadanos. The three parties agree that this law will provide financial stability and guarantee the Armed Forces’ operability. Attached to this point are the so called “Armament Special Programmes”, including the EUROFIGHTER and A400M fixed-wing aircraft, the TIGER and NH-90 helicopters and the new F-110 frigates and 8x8 armoured vehicles. Once again, the three mentioned parties defend the continuity of these programmes, though with some differences concerning the payment mode. While the Popular Party advocates for an extraordinary credit (like it has been for the last few years during its legislature), PSOE and Ciudadanos ask for consideration of the payment as part of the annual budget. As far as the armament sector is concerned, PP will continue its way towards the establishment of a procurement agency, similar to those of neighbouring countries. In addition, the party will continue to support the defence industry as an economic and strategic value and, in this regard, highlights the approval of the Defence Industrial Strategy and the Defence Technology Strategy. For its part, PSOE stresses that Spain should invest in dual technologies and R&D to increase competitiveness and efficiency of aerospace and naval industry. Ciudadanos also assigns a significant economic and strategic value to the defence industry and notes the need to increase the Spanish participation in European and international programmes, identifying the technological areas where there are opportunities for innovation. Podemos, however, focuses on transparency and democratic control and states in its programme that they will regulate the relationship between the MoD and the industry to make them fully transparent and review and audit the procurements to make the budget viable.

As we have seen, despite political divergences, there are no significant differences in the security and defence arena. Only Podemos’ programme has some more innovative points, especially related to personnel matters. But although they have achieved a very good outcome of the elections, they do not have a major influence on the formation of the government because of their political distance from PP, the party with the most votes. So Spain can only hope that political leaders will come to an agreement and form a strong government, able to face the challenges in defence and security, such as Islamic terrorism, the budget crisis and the weakness of the European Union. Without any doubt, a third edition of elections would be a disaster for Spain.

Poland – a Frontline State?

Thomas Bauer

At the NATO Summit in Warsaw in July, a clear message was sent by the Alliance that the aspirations of Eastern European States will be given greater emphasis in the strategic considerations and measures taken to stabilise and secure Europe. Poland has a key part to play in this. The government in Warsaw feels threatened by the increasingly aggressive political and military machinations of Russia: one more reason to take a closer look at the country and its defence policy.

From the security policy perspective, Poland has always had a special and precarious status within Europe. Occupied by Prussia, the Habsburg Empire and Russia at the end of the 18th century the country

Soviet troops in the east of the country, Poland was divided once more, between the German Reich and the Soviet Union. At the end of the Second World War, Moscow incorporated the country, together with all

Al-Qaida and international terrorism. Polish Special Forces were involved in the Iraqi Freedom campaign against the Saddam Hussein regime in 2003. In the aftermath, stabilisation tasks were taken over in the



Photo: NATO

Raising of the Polish flag at NATO HQ in Brussels: Poland became a NATO member on 16 March 1999.

disappeared from the map as a sovereign state for more than 100 years. It was only in 1918 that Poland was reborn as an independent nation in a Europe weakened by war, revolution, and economic recession. In the wake of German aggression in September 1939, followed by the invasion of



Photo: USAF

A Polish patrol is debriefed by the team leader after completing the afternoon patrol around the perimeter of Camp Babylon, Iraq, during Operation IRAQI FREEDOM.

the other Eastern European states, firmly under Soviet dominion. The end of the Cold War in 1990 gave Warsaw the unique opportunity to establish a new framework for safeguarding its national security interests through clear Western orientation and integration into NATO. In contrast to the period before 1939, this also provided the advantage of establishing ties with the USA as a superpower guaranteeing Polish sovereignty. After becoming a NATO member in 1999 and acceding to the European Union in 2004, the country is now securely integrated into the structures of Western Europe. Furthermore, the particularly close relations with the USA led, after 2001, to a very intense Polish engagement in fighting

south of the country, where up to 2,500 Polish troops were deployed. In return, the USA supported the reorganisation of the Polish armed forces and strengthened ties still further within the NATO framework. The Obama administration's shift of the USA's strategic focus away from Europe and towards the Asia-Pacific region was perceived by the Polish government as a threat to its own strategic interests, evoking fears of a worse-case scenario without support of the USA. Warsaw's key role as a door-opener to Europe's neighbours in the East has disappeared over the past few years in the light of an increasingly aggressive stance adopted by Russia and the dispute with Moscow about the deployment of components of a NATO missile defence



Photo: Polish MoD

For the NATO ANAKONDA exercise in June 2016 a scenario was selected in which military units attack Polish territory via the Baltics.



Photo: AIFC

The Polish Army has 247 LEOPARD 2A4 and 2A5 MBTs in service. Some 128 (plus 18 on option) are to be upgraded by 2020 to the 2PL standard.

system inside Poland. Now the strategic focus of the Polish government lies on securing sovereignty and independence by strengthening NATO and the country's ties with the USA.

A Frontline State Again?

With the outbreak of hostilities in the eastern regions of the Ukraine and the annexation of the Crimea by Russia in 2014, the scenario which for many years had been regarded as unrealistic, of Russian aggression in Eastern Europe, was suddenly back on the

political agenda. Provocation in the Baltic region by Russian submarines and reconnaissance flights, which even amounted to putatively deliberate infringements of territorial waters and air space of NATO partners and EU Member States, contributed to a rethink within NATO in favour of placing more emphasis on safeguarding the national sovereignty and integrity of the Eastern European alliance partners. With the NATO exercise referred to as ANAKONDA, a scenario was selected in which military units attack Polish territory via the Baltics, while at the same time hostile forces infiltrate over the bor-

der in the east and south of the country. With more than 30,000 soldiers involved, the manoeuvre sent a clear NATO response to the power aspirations of Moscow, while also serving as a reaction to the concerted manoeuvres last year by Russian and Byelorussian forces.

As well as the NATO ANAKONDA exercise, it was the decisions taken at the NATO Summit in Warsaw in July 2016 that set the course for a stronger military presence by the Alliance in Eastern Europe. The intention is that from 2017 a battalion with up to 1,000 NATO soldiers should be stationed

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Photo: Polish MoD

The Polish Air Force has five type C-130E HERCULES aircraft in service, which were taken over from the US Air Force in 2008

in each of the three Baltic states and in Poland. The battalion in Poland will be led by the USA. At the same time, the Alliance has declared that the disputed missile umbrella over Europe is in part ready to go into operation. Further support for the Ukraine in its efforts to modernise and restructure its own armed forces has also been welcomed by Warsaw, although this does mean an additional commitment by NATO in the buffer zone between Poland and Russia.

Consolidation of the Armaments Industry

After 1990, like many other Eastern European states, Poland was faced with the question as to how recourse to NATO systems could make the modernisation of their own armed forces possible. In this context, right from the outset Poland built on the close relationship with Washington. For the first few years the Eastern European states did not have much freedom of choice in the matter: the West made use of the need for interoperability with the new members, in combination with the reductions in their own ranks brought about by the "peace dividend" after 1990, to scale down over-capacities in the Western European and US forces. Materiel was made available to Poland and to the other Eastern European nations in generous measure. This laid the foundation for the emergence of co-operative projects in the years which followed, in which manufacture of foreign products under licence in Polish factories was frequently agreed. After 1990, the country's armaments industry experienced a major haemorrhage. Of the 250,000 people previously employed in this sector, 15 years later there were only 35,000 left, and by 2010 only 20,000. One main reason for this was the shrinking of the essential sales market: up to 90 percent of the weaponry and military hardware produced in Poland

up to 1989 had been delivered to the other nations of the Warsaw Pact.

The Finance Ministry in Poland, responsible for the privatisation of state concerns, had attempted right from the start, by way of alliances with other sectors in the context of key future technologies, to give the country's ailing armaments industry a much needed shot in the arm. In the end, however, it was the Ministry of the Economy in Warsaw which, by establishing two holding structures in 2003, laid the founda-

Photo: U.S. Army



A Polish ROSOMAK armoured vehicle patrolling a street in Ghazni, Afghanistan, in November 2010

tion for the consolidation of the remaining armaments industry capacities, namely PHZ Bumar and the Industrial Development Agency (ARP). The special feature here was the close coincidence of this consolidation strategy with the modernisation and transformation of the Polish armed forces. In comparison with other nations, from the outset a close relationship was established in Poland between the safeguarding of national economic policy interests, which related to maintaining companies to provide

the technologies regarded as strategically important, and the protection of national security policy interests.

Modernisation of the Armed Forces

Poland's armed forces can be regarded today, at least in parts, as very modern, particularly in the sectors which would be required to interact with Alliance partners within the framework of international engagements. The basis for this is, among other considerations, the fact that Poland is one of the few countries in Europe which abides by the NATO specification of 2% of GDP for defence expenditure. As a result, as well as a parallel restructuring of the national armaments industrial capacity, a large number of cost-intensive procurement measures have been put into effect, even if this trend has lost headway as a consequence of the world economic crisis and the weakened general economic situation in Europe. The modernisation of the armed forces is based on documented principles, in respect of security and defence policy. The current security strategy dates from 2014, and the defence strategy from 2009 is being reviewed and adapted to the

new geopolitical and strategic framework. The Polish armed forces have a total strength of some 100,000 personnel. The larger part is represented by the Army, with 65,000, followed by the Navy with 18,000, and the Air Force with some 17,000. The Army has 247 LEOPARD 2A4 and 2A5 MBTs in service, while the stocks of old T-72 units from Russian production have been steadily phased out over the years. Some 128 (+18 on option) LEOPARD 2A4s are to be upgraded by 2020 to the ZPL standard. There are, how-

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Photo: NATO



The Polish Defence Minister Antoni Macierewicz (right) during a meeting with NATO Secretary General Jens Stoltenberg

ever, some 350 tanks mothballed but ready for action until 2018. Among wheeled AMVs, the KTO ROSOMAK predominates, in a variety of configurations. The ROSOMAK is based on the Finnish Patria AMV, and is manufactured in Poland under licence by Wojskowe Zakłady Motoryzacyjne. (Military Automotive Works, WZM). The company is part of the Polska Grupa Zbrojeniowa (PGZ), which comprises more than 60 companies from the armaments sector, with a workforce numbering more than 17,500. The manufacture of some 1,000 vehicles per year is contractually secured up to 2019. In 2002 Patria won this contract against the PI-RANHA from MOWAG and the Steyr PANDUR. To date, some 570 AFVs have been delivered to the Polish armed forces. A tender has been issued for 118 light reconnaissance vehicles (LRRV) under the ZMIJA programme. Hulls of 36 K-9 THUNDER 155 mm SP artillery pieces are being acquired from South Korea and will be fitted with the indigenous KRAB turret. 79 POPRAD VSHORAD systems are on order. Future modernisation plans include the acquisition of wheeled 155 mm howitzers, divisional MLRS, a new SHORAD system (NAREW programme) and 120 mm SP mortar.

Regarding Army Aviation, a programme to acquire more than 50 multi-role helicopters is underway. In 2015 the H225M CARACAL appeared to have won this contract but the new government has stated its intention to reduce the numbers pertaining to this contract and to re-open negotiations with Lockheed Martin / Sikorsky for local manufacture of the S-70i BLACKHAWK.

Following a comprehensive renewal programme, the core of the Polish Air Force is 48 F-16C/D Block 52+ FIGHTING FALCON aircraft. These represent the new policy of

“class not mass”, or “quality v quantity” under which the ORBAT of more than 600 aircraft has been thinned down to less than 120. Alongside the FIGHTING FALCON there are still 35 MiG-29 FULCRUM aircraft in service, from the residual stocks of the GDR, which were taken over in the 1990s by the Bundeswehr. There are also 18 Sukhoi Su-22M4 FITTERs still operational from the Soviet days. Both the MiG-29 and the Su-22 units should actually have been taken out of service by 2012, but the tight budget and lack of successors meant that the last representatives of the old Warsaw Pact days will probably still be around until 2018. With regard to air transport, the Polish Air Force is centred around five type C-130E HERCULES, which were taken over from the US Air Force in 2008, and which, after a modernisation programme in the USA, started their Polish Air Force service in 2009. Added to these are 16 CASA C-295M transport aircraft, which since 2001 have been steadily replacing the antiquated Antonov An-26 transport aircraft. The Air Force also has a number of attack and transport helicopters in service, again with a considerable number of Warsaw Pact veterans represented, including 28 Mil Mi-24 HIND attack helicopters, and 56 Mil Mi-2, -8 and -17 units. Added to these are also 70 PZL W-3 models in different configurations, manufactured in Poland. The Aermacchi M-346 MASTER has been selected for the Advanced Jet Trainer programme (8 aircraft plus 4 on option) and acquisition of 32 attack helicopters is planned under the KRUK programme to replace the Mi-24s. These 32 helicopters will be split between the Air Force and the Army Aviation.

Polish Navy surface vessels are currently undergoing a migration from larger ships (frig-

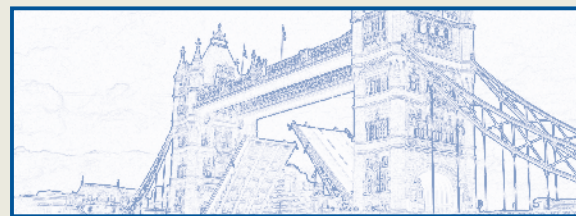
ates) to smaller classes such as minesweepers and corvettes, since these are regarded as better suited to operations in the Baltic. Conversely, the strategic reorientation of the navy towards international operations means a shift in focus towards submarines. In this context, by 2030 2 + 1 new submarines will be procured, which are intended to bolster the existing single KIL0 class boat, and to replace the 4 boats of the KOBLEN class. ORP SLAZAK, a Project 61 OPV, is expected to be commissioned in October 2016; in November 2016 the lead ship (of 3) of the KORMORAN II MCMV programme will be commissioned. The naval component of the Modernisation Plan calls for 3 coastal defence missile corvettes, 3 patrol vessels on the same platform, and a second coastal defence battalion from Kongsberg.

Outlook

In an article in the Economist from 2014 about the defence and armaments challenges facing Poland, under the heading “A Front-line State”, a debate was reopened that had been overshadowed in the years following the 9/11 attacks by the international fight against terrorism; namely, the stability and security of Europe’s borders: “With neighbouring Ukraine in turmoil, Warsaw is more acutely aware of its vulnerability than at any moment since the end of the cold war. Russia’s annexation of Crimea, its support for the insurgency in eastern Ukraine and its aggressive Russian-Belorussian war-games in recent years, not far from Poland’s eastern border, have made policymakers much more aware that the country faces a real security risk.”

For Poland, as for the three Baltic States, the existential question of state sovereignty is accordingly tied to a real security threat. Any fluctuation or uncertainty in the fundamental national security and defence policy could be interpreted by Moscow as an internal weakness of the individual countries, or – which Poland finds even more unsettling – could be interpreted as an indicator of marginalisation of NATO in Eastern Europe. It is therefore of particular significance for Warsaw that the transatlantic alliance sets about bolstering its position in the East European security landscape: the associated diplomatic skirmishes with Moscow will be happily accepted. Poland will continue to make itself heard with its own substantial contribution to Power Projection, inasmuch as its own budgets will allow. Integration in transnational groupings and command structures, such as the Multinational Corps Northeast (MNC NE), are a guarantee of this – and, at the same time, an obligation. ■

Viewpoint from London



Tim Guest

Security Implications of Brexit

A lot of things have been happening in London in the past few months. Some might well impact the UK's state of security in the coming years, yet with so many front-page-worthy developments, it's hard to know where to start. This is made doubly difficult, considering important political events have now been overshadowed by awful terrorist acts in France and Germany of recent days and weeks, but let's try.

June saw a Brexit decision for the UK to leave the European Union. The decision has certainly stirred up a hornet's nest, both here and abroad, and it raises justified – and unjustified – questions about future security. July then saw the publication of the long-awaited Chilcot Report on the Iraq War, which, after a seven-year wait has delivered more than had been expected, in terms of pointing the finger of blame for misinformation and untruths at key political figures and agencies. It also potentially leaves room for a certain ex-Prime Minister to land in court somewhere down the road. And with the Brexit decision, the incumbent PM, hoist by his own petard for calling a referendum on Europe in the first place, felt the need to resign, leaving the Brexiteers to their own devices – and seeming chaos. Days of almost comic political shenanigans, which also saw those “leaders” who had conspired to achieve Brexit disappear from public view, seem now to have been steadied by the fairly quick-order appointment of a new PM in the guise of one, Mrs Theresa May, former UK Home Secretary. She appears to have brought order to the chaos, (for the moment at least), and since moving into 10 Downing Street has achieved some crucial results, presiding over the important, security-of-the-realm decision to renew Trident and meeting with both French and German leaders.

A friendly first meeting with Angela Merkel saw the German Chancellor agree with May that, rather than a rapid instigation of Article 50 to get the UK's break from the EU underway immediately, the UK should take time to consider exactly when and how to set the move in motion for the benefit of all. She added that irrespective of the decision to leave the EU, the two countries were linked by “very close bonds of friendship and partnership”. She said that having always acted with similar convictions and values, such factors as both countries being members of NATO would determine the relationship and the spirit in which negotiations on the UK leaving the EU would be carried out.

When it came to meeting French leader, Francois Hollande, the new PM displayed a degree of competent statesmanship and although Hollande reiterated the need to move on Brexit at the earliest time, he also accepted time was needed for the UK's plan to be set out clearly. On one immediate security issue, both settled on maintaining the Le Touquet agreement for UK border checks to continue to be conducted in Calais in order to control refugee and migrant flow across the channel. In light of the awful attacks these past two months in France, this is a crucial victory for common sense.

Yet, in the background are many commentators who believe Brexit might well damage European defence cooperation, largely by upsetting the relatively sound political relationships that have existed with the major EU and NATO partners, France and Germany. This doesn't worry those who favoured Brexit, as they lobbied for a long time that EU defence policy could undermine NATO, anyway. A departure from the union, they inferred, would not inflict a problem for a going-it-alone UK, as the country is already the second most important NATO member and its status would not be impacted by an EU departure. The flip side of the coin is that without the UK in the EU, some members might take steps to strengthen the EU's defence alliances and activities, potentially at the expense of a stronger NATO and such moves would no longer have UK vetoes and objections to keep them in line.

For his part, NATO Secretary General Jens Stoltenberg said that it would take time to understand the full ramifications of the Brexit move on security. He said that the UK remained a “strong and committed ally, responsible for almost one quarter of defence spending among European NATO Allies” and that the country's position within the alliance would remain unchanged after Brexit. Ever the diplomat, he balanced this UK stance by stressing the importance of NATO-EU cooperation and outlining areas such as maritime security and “hybrid warfare” where more collaboration was crucial. Once the dust settles and political posturing subsides, hopefully the common sense of the military minds across western Europe and within NATO will get on with the job that needs doing. Don't forget, Mr P is watching all this with intrigue and a common terrorist threat needs cooperative intelligence and defence to be defeated. No matter what's going on politically, it's a time for total teamwork, militarily.

The Effects of Finland's Possible NATO Membership

Conclusions of a Recent Assessment

Mats Bergquist, René Nyberg, François Heisbourg and Teija Tiilikainen

The Ministry for Foreign Affairs of Finland commissioned an assessment of the effects of Finland's possible NATO membership, in connection with the preparation of the Government's Report on Foreign and Security Policy.

The assessment that was published in April 2016 was the first of its kind to be conducted at the request of the Finnish government since 2007: during the intervening decade, major strategic changes had occurred at the global, European and regional levels.

The assessment was carried out by an independent group of experts (Mats Bergquist, François Heisbourg, René Nyberg and Teija Tiilikainen), which was not entrusted with voicing a preference for or against NATO membership. It was tasked to provide an evaluation of the potential effects of membership, which were not all considered equally straightforward. The final report comprising 62 pages and divided into four main chapters is based both on interviews and rich secondary material. This article summarises the main points of analyses and key findings of the report, paying special attention to one of its parts, namely

the implications of NATO membership for Finland's defence policy.

Finland's Position in the European Security Political Architecture

Finland has come a long way since the wars, hot and cold, of the twentieth century. In the process, the country has

learned to manage complexity in international relations and security affairs, with its demonstrated will both to defend itself and to establish a *modus vivendi* and a stable relationship with Russia. As the benign strategic context of the post-Cold War era gives way to a harsher and less predictable dispensation, Finland needs to adapt yet again to changing circumstances. The assessment of the effects of possible NATO membership can be seen to contribute to that adaptation.

Finland is a Western country, a member of the broader family of like-minded democracies. In this regard, the post-Cold War era was a homecoming, with the country gaining EU membership in 1995. This European dimension is part and parcel of Finland's

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Four Nordic countries, three different political alignments: Denmark is a member of both NATO and the EU, Norway is a part of NATO but not of the EU, and Sweden and Finland are members of the EU but not the NATO. The border that Finland shares with Russia is 1,340 km in length.



Map: climbtherock.de

new identity. As a result, Finland ceased to view itself as a non-aligned country once the EU treaties included military assistance clauses, with its legislation being reviewed accordingly, even while maintaining its policy of not joining military alliances.

Given its full European integration, Finland shares the broader strategic concerns of its EU partners, along with the rising challenges both to the east and south of the continent. However, the EU does not possess the institutions and capabilities to deal with the full range of these strategic concerns by itself. Finland remains deeply aware that there is no solution to the specific strategic dilemma posed by its unpredictable neighbour, which requires continuous management. Nor is it prudent to assume that a common European security and defence policy (CSDP) capable of doing so will emerge in the foreseeable future. The same applies mutatis mutandis to regional cooperation, which is both absolutely necessary but clearly not sufficient given ongoing security challenges.

Finland has developed a policy of engagement with all partners and organisations each contributing in their own way to security in Europe, notably the OSCE, Nordic cooperation, the EU and NATO. Finland, like Sweden, is nearly as close to the Atlantic Alliance as it is possible to be for a non-member state, reaching a plateau. This convergence at military and diplomatic levels has in turn led to a considerable degree of interoperability between Finland and NATO. The practical difficulties that would have to be resolved were Finland to join NATO are quite limited. This is due both to Finland's democratic credentials, and to the perception that Finland is a militarily serious country underpinned by the reality of its territorial defence. Finland's "Bündnisfähigkeit", its practical readiness to be a full member of NATO, is correspondingly high. From the NATO perspective, Finnish accession would be technically straightforward and – in all likelihood – acceptable to member states.

Finland and Sweden constitute a common strategic space and have compelling reasons to make the same fundamental choices as to their future security and defence, whether on the basis of the current policy of convergence with NATO, short of membership, or with a view to joining the Atlantic Alliance. As Western and European democracies, they share the same Nordic and Baltic space, and they face the same strategic challenges and uncertainties in that region. This strategic reality applies notably to the security of the Baltic States. Throughout Finland's history as an independent state, strategic decisions taken

by one of the two countries have had immediate and decisive consequences for the other. By working together, Finland and Sweden can have greater influence inside or outside NATO, as was the case in their decision to join the EU more than twenty years ago. Conversely, divergent choices in Finland and Sweden would produce new difficulties. Finland would be more exposed and vulnerable than it currently is if Sweden alone were to join NATO. This would also create a serious challenge for Stockholm, the return of the 'Finland question', which had waned with Helsinki's ability

is not viewed by Russia in the same light as Ukraine or Georgia, indicates that political and economic reactions may be strong, even harsh, notably during the transition phase. Even while stopping short of the use of force, specific counter-measures would be difficult to predict.

Finland's accession to NATO – if such were the country's choice – would involve intricate diplomatic and political processes, not least since accession would probably take place in a more charged international atmosphere than previous enlargements. Externally, there would be every reason to



Photo: presidentti.fi

Finnish President Tarja Halonen visiting the Finnish ISAF forces in Afghanistan in January 2011

to stabilise its relationship with the USSR and move into Western structures during the Cold War. Finland joining NATO with Sweden staying out would create a strategically awkward situation, leaving Finland as a strategic outpost without territorial continuity with NATO.

Finland, as a member of the EU and as a Western democracy, shares with its partners a broad array of strategic concerns, calling for solidarity and common action. However, geography gives particular importance to Russia, with which Finland shares a 1,340 kilometre-long border. As an unsatisfied power, Russia has made unpredictability a strategic and tactical virtue, underpinned by an impressive degree of political and military agility. Russia has taken a revisionist stand against the norms and principles governing the European order. It regards the Atlantic Alliance as an adversary and considers any NATO enlargement as a threat to its national security. Hence, Russia will attempt to thwart any move by Finland or Sweden to join NATO.

The historical record of previous NATO enlargements, despite the fact that Finland

shorten the transition period between the membership application and admission into NATO, since this would be the time of maximum antagonism by Russia.

However, even if a 'fast-track' accession process could be agreed upon by the members of NATO, it would run counter to the probable need to manage two membership processes in parallel in Finland and Sweden. These processes may involve referenda, with uncertain outcomes, which could lead to split decisions and their ensuing consequences. A possible fast-track should not be allowed to interfere with the full democratic due process that such a weighty decision calls for. Indeed, an in-depth and possibly lengthy public debate has virtues of its own, if this portentous issue is not to fall prey to the froth of short-term and superficial discussion.

One can but underline how fundamental such a decision would be. It would represent a sea change in policy, which must be considered as a commitment for the long-term. A small country such as Finland has good reason to be careful when considering choices of grand strategy.

Defence and Military Implications of Finland's NATO Membership

From the NATO standpoint, Finland would fit readily into the NATO family in practical terms. Its military forces meet NATO standards, and its defence and strategic posture vis-à-vis Russia is consistent with NATO aims and policies. From Finland's perspective, the same remark applies: NATO policy and requirements are generally congruent with the needs of Finnish defence policy. As a member of NATO, Finland would be directly involved in NATO defence planning and in the command structure. This would represent a step-change vis-à-vis current military cooperation by Finland with NATO: Finland would be part of the overall benchmarking process between the members, and a measure of coherence could be established between Finnish defence preparations and the collective and individual preparations of NATO and its members. Given the recognised qualities of the Finn-

ish politico-military establishment and its intimate cooperation with NATO and NATO partners, "plugging" into these aspects should be straightforward. Finland's high level of interoperability with NATO can be exemplified by Finland being one of the very few non-NATO countries to be part of the Link 16 data exchange system between combat systems, such as its F-18 aircraft. With the exception of air surveillance and control, where there is substantial leeway for improvement, Finland is probably reaching the limit when it comes to generating increased interoperability with NATO (and therefore by ricochet with the EU) without being a full member of the Alliance. Entering NATO's full-spectrum planning process under the Defence Policy and Planning Committee (DPPC) will not be possible outside of full membership. The same applies to the Very High Readiness Joint Task Force (VJTF), part of the enhanced NATO Response Force (NRF). The VJTF is optimised for Article 5 tasks. The current changes being mooted in Finland in terms of the rapid activation of reservists and the more flexible use thereof are fully in line with the short-warning time threats that NATO aims to deter and, if need be, to defend against. If Russia were to substantially increase the forces arrayed in proximity to Finland, Finland may have to review its dispositions, for instance with further increases in readiness. It does not have the option of adopting the equivalent of Norway's "Finnmark policy". For a power advancing from the East, Finnmark was a strategic dead end during the last World War and during the Cold War and remains so, unlike Finland whose territory opens access to the whole Baltic basin. Finland as a member of NATO could draw on allied solidarity to buttress Finland's defence in the form of prepositioned materiel

an excellent school for developing interoperability.

In the event that Article 5 entered into play in defence of the Baltic States, only the major powers could provide heavy military muscle: Finland's contribution would in all cases be militarily limited. NATO's Very High Readiness Joint Task Force (VJTF) may play an important role in case of an Article 5 crisis in the Baltic States. Finland as a possible NATO member could aim at providing a limited but cutting-edge contribution to that unit along with its existing participation in the NRF. The VJTF in toto is planned to comprise some 5,000 soldiers from the overall NATO family. Overall, however, NATO membership should not lead Finland to develop its expeditionary component substantially.

Finland's defence infrastructure is close to NATO standards and could be plugged into integrated NATO without substantial difficulty if the basic mission is the defence of Finland. The most significant move would be the integration of Finland's air surveillance and management networks with NATO's Air Command and Control System. If Sweden stays out of NATO, Finland would presumably be invited by NATO to also make its logistical infrastructure fit for use by NATO reinforcements to the Baltic States. The implications this would have from the Finnish standpoint would require a specific technical evaluation by Finland's MoD in concert with NATO.

It can be assumed that Finland-in-NATO would not request the deployment of nuclear weapons on its territory, nor that Finland would acquire combat aircraft on the basis of their ability to deliver nuclear weapons. However, Finland would have to decide whether it would join NATO's Nuclear Planning Group. For the time being, this is the case for 27 out of 28 members (only nuclear-armed France withholds its participation). Belonging to the NPG provides participant states with information on NATO's nuclear doctrine and planning but does not imply participation in nuclear missions per se. Even NATO countries such as Denmark, which objected publicly in the past to NATO nuclear policy, never ceased to be part of the NPG.

Members of NATO and of the NPG that do not have nuclear weapons on their territory are not expected to task their combat aircraft with nuclear strike missions. They can nonetheless play a part in the execution of such missions in the form of a fighter escort or the suppression of enemy air defences (SEAD), for instance. That is a matter of national choice, however.

NATO as such is a relatively low-cost organisation. Its annual infrastructure expendi-



Photo: nordicdefence.com

Finland is one of the very few non-NATO countries to be part of the Link 16 data exchange system between combat systems, such as its F-18 aircraft.

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and the more or less sustained presence of allied forces, with a view to reducing the risk of Russian miscalculation. Finland's territorial defence does not lend itself readily to out-of-the-country military intervention. The importance of territorial defence for Finland implies that expeditionary capabilities should not be developed to the point of making territorial defence unsustainable, and thus put the Baltic basin at risk. However, Finland has already participated in military operations abroad, including in NATO and EU formats: with, in the past, up to 800 troops in KFOR Kosovo, a construction battalion in IFOR and SFOR Bosnia, and a company-sized commitment in the German sector of ISAF Afghanistan. No less importantly, it is also a force contributor to NATO's Response Force (NRF),



Photo: wordpress.com

Finland's GROUND MASTER-403 radar systems providing a surveillance range of up to 470 kilometres would have to be integrated with NATO's Air Command and Control System, should Finland join the Alliance.

ture amounts to some EUR 5.2 bn. In view of Finland's GDP as a proportion of NATO's total, its share should be slightly in excess of 1%, meaning less than EUR 55 million in practice. These costs should rise in the near future given the currently unsatisfactory state of defence preparations in and towards the Baltic States. To this must be added the human resources cost of Finnish personnel working within the NATO framework in case of membership. NATO currently has an international staff of 1100, and 6700 military and civil servants in the command structure. Using the same ratio, this would represent about 80 people from Finland.

NATO's benchmark for defence expenditure is set at 2% of GDP: out of 28 members, only four countries (including neighbouring Estonia) meet it, possibly joined by a fifth (Poland) in 2016. Finland's defence budget of EUR 2.69 billion stands at 1.3% of a GDP of EUR 207 billion. However, ac-

cording to an assessment made for the report, the figure rises to EUR 3.41 billion and 1.64% of GDP on the basis of NATO definitions. To close the gap, annual expenditure would have to increase by approximately EUR 730 million.

Preserving conscript-based territorial defence while increasing readiness and modernising the force structure (e.g. the upcoming combat aircraft and naval equipment purchases) will require an increase in spending, whether or not Finland joins NATO.

Concluding the Political Implications of Finland's NATO Membership

A decision to join the Atlantic Alliance and its Article 5 collective defence commitment would represent a sea change, transforming Finland's security policy overall, and its relationship with Russia in

particular. Paradoxically, the deepest effects would not be in the sphere of military policy and dispositions: membership of NATO would not entail a marked departure from the long-standing Finnish choice in favour of a conscript-based territorial defence. The shift would be geopolitical and strategic in nature, as momentous, for example, as Sweden's decision to become neutral some two centuries ago, or Poland joining NATO at the end of the nineties. These were decisions conceived for the long haul, which transformed the positioning of these states as political and strategic actors. In other words, the decision to join NATO would not be a mere incremental extension of Finland's increasingly close partnership with NATO.

Second, in the security of countries, the timing of decisions is of the essence. Likewise, decisions should not be rushed. An accession process should be based on the dual understanding that it is a long-term commitment and that applying for membership could be difficult once a strategic storm has broken. Symmetrically, a decision to pursue the current policy of cooperation with NATO short of membership should be viewed in the same light. The possibility to apply for membership remains a tool to master the geopolitical dilemma posed by an unpredictable neighbour.

Finally, as has repeatedly been proposed, the effects of possible NATO membership would be considerably more benign for Finland if such a decision were made in a coordinated manner by Finland and Sweden, than if Finland joined alone. Similarly, a Swedish decision to join NATO and a Finnish decision not to join would leave Finland isolated and exposed. ■

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Delivering Security in a World of Dynamic Instability

Photo: NATO



Petr Pavel

The NATO Summit in Wales in 2014 was defined by the challenge to find rapid and effective responses to the Russian use of military means to pursue political aims beyond the limits set by international law.

The speed of Russia's actions in Crimea and Eastern Ukraine caused much attention, specifically for those nations in Russia's geographical vicinity. In view of their concerns, the Alliance's adaptation decisions in Wales, including the emblematic Readiness Action Plan (RAP), served two purposes: to assure eastern Allies of Alliance solidarity and unity through enhanced, albeit rotational presence, and to deter potential aggressors via increased Alliance's responsiveness. Finding the right balance between these elements – forward presence and responsive forces – has been the subject of ongoing debate within the Alliance since then. Naturally, those nations geographically exposed to potential Russian military aggression strongly advocate deterrence via a multinational forward presence.

Solidarity and Cohesion

There is to a certain extent a historical parallel to the famous conversation between French and British Generals Ferdinand Foch and Henry Wilson in 1910. Wilson, then the Chief of Operations of the British Army

asked about the French desire for the scale of a British contingent in a potential war with Germany. Foch responded "a single British Soldier, and we will make sure that he is killed". This means the additional deterrence effect of multinational troops is not based on sheer numbers and capabilities but is the result of their multinational composition, which ensures an Allied collective reaction in case of an attack.

As NATO's Chiefs of Defence recently recommended a forward presence of four battle groups, one for each of the Baltic States and one in Poland, there is agreement on the shape of this presence. This sends a clear message of strength, decisiveness and, at the same time, of unprovocative modesty in order to leave the door open for dialogue to Russia. There is also a domestic element in this message, of solidarity and cohesion among all Allies, the core of the Alliance's strength.

Regardless of the value of forward presence, the most credible deterrence against the entirety of the dynamic threats surrounding NATO is its ability to provide modern, highly-trained, rapidly mobile forces

The Wales Summit also signalled NATO's ability and preparedness to address all other challenges to Alliance security with an emphasis on the threats stemming from non-state actors emanating from the Middle East and Northern Africa. The Warsaw summit had to complete this work and to show NATO's way ahead in a world of dynamic security changes.

In hindsight, Russia's use of the military instrument of power to advance her political ambitions two years ago was not truly surprising in view of the messages given before. The Russian leadership had repeatedly stated in public that Russia's interests were in opposition to those they perceived as the Western (i.e. US, NATO and EU) ambitions in her so-called near abroad. Consequently, Russia had two options – to see her influence drastically diminished by the allure of successful Western societal and economic models, or to deploy her competitive advantages to this quest, which are rapid decision making, the use of military means through hybrid tactics, and effective state orchestrated domestic media support.

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General Petr Pavel meeting NATO Secretary General Jens Stoltenberg

Photo: NATO

operating at a very high state of readiness. A reinvigorated increased responsiveness model has been implemented and tested with the Very High Readiness Joint Task Force, or VJTF. Established in 2015 shortly after the Wales Summit, it is composed of Air, Land, Maritime and Special Forces elements. Its deterrent credibility remains dependent on effective and uncontested deployment options. NATO is therefore constantly improving the conditions for these forces' responsiveness, including counter anti access/area denial measures, an issue that had the full attention of the Chiefs of Defence at their meeting in May. A component of the complexity in the contemporary security environment lies in the fact that actors may have simultaneous competing, adversarial, and partially compatible interests. Consequently, NATO's stance towards the challenges in the East is not only based on deterrence. Deterrence is not a replacement for a strategy, it is just one of several strategic effects. So it is not as clear as "deter or engage" and NATO is not preparing for a new Cold War. The Cold War was, comparatively, an era of stability with predictable actors on both sides. NATO is adapting to a security environment in which the use of military means for political purposes is no longer excluded by some members of the international system and in which non-state actors have the ability to locally challenge the security of well-established state actors.

Furthermore, threat is defined as based on both capability and intent. To understand the intent of a potential adversary, we must have dialogue – and we also need to be understood. Deterrence, defence, and dialogue are therefore the triad that will allow us to avoid miscalculation and to achieve conflict prevention.

Hybrid Warfare

Another part of NATO's adaptation has focused on ways to deal with so-called hybrid warfare. Hybrid confronts us with the paradox of being challenged by weaker competitors or adversaries. Many scholars and military strategists have presented the hybrid nature of Russian military activity in Crimea and Eastern Ukraine as a new phenomenon. But hybrid warfare is designed just as all other forms of warfare, in line with the traditional Clausewitzian definition of war as "an act of violence intended to compel our opponent to fulfil our will". So it is more a symptom of the changed security environment rather than something genuinely innovative to be addressed separately by a strategy.



Photo: CPO J.PARRACHO (PRT Navy)

Task group commanders participated in a meeting with the commander of the task force on HMS OCEAN, prior to the start of the TRIDENT JUNCTURE Tactical Phase.



Photo: NATO

Canadian troops during a MOUT exercise

An aggressor using hybrid means is just bringing his competitive advantages into a conflict. Hybrid is the way for an inferior competitor to achieve what would have been unattainable if he had played according to the rules of international law. In so doing, he aims to avoid a large-scale response by other actors and conducts his activities below the threshold of open war. It has been said on various occasions that hybrid needs fruitful ground; it finds breeding ground in places where a state and a society offer vulnerabilities to be exploited by the hybrid aggressor. Counter hybrid is consequently first and foremost a domestic responsibility, as the most effective countermeasure is to strengthen the resilience of the society through economic and social welfare initiatives. Therefore, hybrid is one of the areas of NATO-EU cooperation, as it has to be addressed comprehensively with all instruments that state and society can offer.

NATO's biggest challenge in countering hybrid is the clear identification of an activity as part of a hybrid attack and subsequently the selection of the right countermeasure to effectively address the hybrid attacker.

Hybrid is, as most of the publicly disputed security developments of the recent past, an operational phenomenon, not a strategic one. Per se it does not require a new NATO Strategic Concept. The post-Wales discussion showed that the Strategic Concept agreed in 2010 allows for ample flexibility to address today's concerns, as well as those of tomorrow. In essence, the 2010 Concept provided for the Alliance's ability to adapt. The Strategic Concept as it stands offers a proper framework for the four Military Strategic Effects that the 28 NATO CHODs agreed to be necessary to translate NATO's strategic superiority into the desired political outcomes. These Military Strategic Effects are: Deter, Contain, Protect and Project. They can be used in isolation, in tandem, or collectively; however, they are always to be embedded in a wider strategic approach leveraging all instruments of power to achieve a political goal. By employing the adequate Military Strategic Effect as part of an overall strategic approach, nations and the Alliance can react flexibly to the variety of threats facing the Alliance, whether state or non-state actors, dormant or acute.

Photo: NATO



A B-52 H STRATOFORTRESS bomber of the US Air Force during air refuelling

Photo: COMBAT CAMERA TEAM of LPAO CHINCHILLA TJ15



During an air assault operation, two CH-47 choppers performing Special Patrol Insertion/Extraction (SPIE) and fast roping with Spanish SOF soldiers at Chinchilla training area, Spain, on 27 October 2015 during TRIDENT JUNCTURE

Photo: German Navy



From front to back: German frigate HAMBURG, French frigate SURCOUF, Bulgarian frigate DRAZKI and German frigate SACHSEN participating in a manoeuvring exercise in the Mediterranean Sea during TRIDENT JUNCTURE on 29 October 2015.

Regional and Comprehensive Approach

The optimal employment of the military strategic effects in concert with all instruments of power would require a strategic framework like the one recently agreed for NATO's further adaptation to the challenges from the South. Such a framework is indeed the link between the Strategic Concept and the existing and potential individual measures that provide granularity to NATO's posture towards the security challenges the Alliance is facing.

There has been a consensus for a long time that in a modern world we cannot address security issues country by country. We need a regional and comprehensive approach. Even when we design measures for a specific country, we need to assess the repercussions for the region. Any foreign engagement regardless of its nature must be based on this principle. It must be complementary to existing initiatives, whether national or multinational. Complementarity is a must especially with the European Union, which has impressive, wide ranging diplomatic, economic and financial tools at its disposal. However, complementarity is already a challenge inside the EU, given the complex relationship between the European Union External Action Service, responsible for EU foreign policy, and the EU Commission, which directs, amongst others, the powerful instruments of development and trade.

Additionally, NATO-EU relations continue to be overshadowed by the fact that the EU member Cyprus is not recognised as a state by Turkey. However, this does not prevent both organisations from having strong informal military contacts, also based on 22 EU members being NATO Allies.

NATO's projecting stability initiative will follow this complementary approach. Based on the principle that it is more sustainable to enable local forces to protect their own countries than it is to deploy large numbers of own troops, this initiative will focus on building local capacity.

NATO Missions and Operations

NATO's Resolute Support Mission in Afghanistan is already projecting stability. Since January 2015 NATO has switched to supporting local forces by providing training, assistance and advice to the Afghan National Defence and Security Forces (ANDSF). This recognises the importance of ANDSF performance in building up Afghan peoples' trust in the future of their state and society. In May 2016 NATO Foreign

Ministers endorsed the Chief of Defence's recommendation for an extension of the mission into 2017, acknowledging that the conditions for a significant change of the mission's footprint have not been met.

There is also a growing acknowledgement of the Resolute Support Mission's importance in the strategic context of fighting non-state terrorism. The understanding is that any security vacuum would give terrorism the space to grow, any local reduction in pressure will increase leeway to gain the initiative in other places, as has been clearly demonstrated in Iraq, Syria and Libya. Consequently, regional and sometimes global repercussions need to be assessed not only where NATO engages but also where the Alliance disengages.

The strategic impact of NATO's operations and missions and their linkage to the other international aims is also reflected through the planned change of NATO's Operation Active Endeavour into a non-article V type of operation. In doing so, NATO will be able to complement EU Operation Sophia's efforts in the central Mediterranean with the desired political effect of a more stable Libya and subsequent reduction of migration. Even the long-standing KFOR mission in Kosovo has to be seen in the wider aspect of its contribution to regional stability and not narrowed down to the immediate impact it has on Kosovo itself.

On a final note, the focus on operations, enhanced forward presence and high readiness forces should not distract from the fact that supporting NATO's three core tasks – collective defence, crisis management and cooperative security – will always require full spectrum capabilities. Only with the entirety of modern military prowess does NATO have the ability to apply the aforementioned four military strategic effects crucial to achieve the Alliance's political aims. The full spectrum includes the totality of joint warfare, all components of land, sea, air, and special operations as well as nuclear and cyber capabilities.

Nuclear Capabilities

The issue of nuclear capabilities is gaining importance as a result of Russia's doctrinal incorporation of nuclear weapons as a continuum of capabilities rather than maintaining them separate due to their specific nature. As stated in the 2010 Strategic Concept, "as long as nuclear weapons exist, NATO will remain a nuclear alliance". While the "supreme guarantee of the security of the Allies (...) provided by the strategic nuclear forces of the Alliance, particularly those of the United States" is clearly expressed in that document, a sub-



Photo: NATO

US 82nd Airborne Division parachute airdrop from a C-17 GLOBEMASTER III during TRIDENT JUNCTURE



Photo: NATO

A Portuguese tank clears the road ahead of Canadian combat engineers and the multinational brigade convoy in Santa Margarida, Portugal, during JOINTX 15 as part of NATO's exercise TRIDENT JUNCTURE on 29 October 2015.

sequent conceptual framework regarding the future composition was not addressed. The Secretary General explicitly mentioned the need for such a framework at the Munich Security Conference when he underlined that "Russia's rhetoric, posture, and exercises of its nuclear forces aimed at intimidating its neighbours" cannot go unanswered.

Challenges

In sum, the Alliance is challenged. The Russian challenge is the more obvious one, defined by robust capabilities, but to a much lesser extent by a clear intent. Consequently, the military answer is easier to develop and will consist of the modest but decisive answers described above. Finding the right strategic approach to Russia with its manifold character as opponent, competitor, but also potential partner, with

its long-standing role as a major power, as more a political than a military question.

The southern challenge, in which the intent outweighs the capabilities, is a way more complex challenge – albeit that there is strategic consensus on the character of the threat and the impossibility of dialogue with the leaders behind. The potential military portion of a comprehensive approach that stabilises nations and their society and economy in a way that encourages people to believe in a future of their own countries is not yet defined. Current engagements are of tactical, local and short-term nature. The debate for the years to come will be about the development of an overarching approach underpinned by strategic patience and leveraging all instruments of power for the benefit of our mutual security. NATO's Military Committee is looking forward to substantially contributing to this debate. ■

The Slovenian Armed Forces

Recent Developments and Future Challenges

Andrej Osterman

Since 1991, the Slovenian Armed Forces (SAF) has developed intensively, but the transition from the system of own defence to the system of collective defence as well as the transition from a conscript to a professional army has had a significant impact on its development.

The SAF, together with the Ministry of Defence and other government bodies, has intensively prepared for entry into the Alliance. In 2004, when Slovenia joined the Alliance, its defence system was ready for new requirements. The SAF has constantly been marked by important transformational changes. Significant progress has been made in the area of increasing military capabilities; the SAF has acquired new weapons and equipment, and increased the number of professional and contractual members.

Photos/Graphic: SAF



Professionalisation

The last conscripts finished their mandatory military service in 2003 and since then, we can speak of a professional army. Careers were becoming increasingly important both for individuals and the organisation; they had to be based on the acquired competencies needed to perform a specific duty, and the associated advancement in the military hierarchy. With the transition from a conscript to a professional army, major changes were carried out, both in mindset and the mode of operation. With awareness of how difficult the transition from a conscript to a professional army is, the PROVOJ (professional armed forces) project was established in 2003. Its purpose was to propose solutions and necessary activities to transition from a conscript to a professional army. The project also included and presented the possible risks.

Moreover, the intensity of individual and collective education and training increased. The SAF General Staff and its three subordinate operational commands underwent

transformation with the establishment of the Force Command, thus clearly delineating the reach of responsibilities between the strategic and operational levels. Participation in the Partnership for Peace (PfP) programme was strengthened. The SAF was becoming more actively and intensely involved in international operations and missions as well as in international military exercises. In 2000, the SAF deployed its first members to Kosovo, and in 2004 to NATO's ISAF mission in Afghanistan.

After joining the Alliance, the SAF was provided with new opportunities for cooperation with other armed forces of NATO member states. It participated in several joint training courses for operation under various conditions, in joint projects and experiments, in the lending of military equipment, in the exchange of data and other activities.

Professionalization has affected the command and control system, which has to be rapidly responsive in order to allow the SAF to smoothly and properly perform its tasks in Slovenia and abroad. Worth mentioning is also the establishment of the non-commissioned chain of command and the NCO corps.

Mid-Term Defence Programme

The Mid-Term Defence Programme 2016–2020, adopted by the Government of the Republic of Slovenia, is an important development document for the SAF. It defines the objectives and key guidelines for the operation and development of the Slovenian defence system in the mid-term period of 2016–2020, and takes into account Slovenia's financial capabilities assuming only a minimum increase in defence expenditure after 2015. Considering the commitments taken at the NATO Summit in Warsaw, Slovenia plans to increase defence expenditure in the budgets for 2017 and 2018, respectively.

"Between 2017 and 2019, the SAF with troops at various levels of readiness will take part in the VJTF, which will be established and led by Italy. The Republic of Slovenia will man the multinational NATO command elements in NATO Command Structure (NCS), NATO Force Structure (NFS) and NATO Force Integration Units (NFIU), and will contribute an agreed share of troops to NATO Response Force (NRF / VJTF). In accordance with NATO's '28 for 28' principle, the Republic of Slovenia will set the final extent of participation in the VJTF for the period 2017–2019." (Mid-Term Defence Programme 2016–2020, p. 21-22/50)

Since Slovenia joined the Alliance, the SAF has seen more success in some areas of development, and less in others. It is a fact that not enough financial resources have been invested in the modernisation of firing ranges and training areas, and in the adaptation of barracks for the needs of a professional army. In the future, the SAF, the Ministry of Defence and other government bodies will thus be faced with new challenges in this respect.

Due to the constant reductions in defence budget as a result of the financial situation in Slovenia, the SAF development challenges will have to be faced and accepted gradually by taking into account

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Members of a Slovenian ISAF contingent during shooting training in 2013

the financial and other capabilities, but mainly by applying tolerance and reason. It would also be wise to consider amending the Mid-Term Defence Programme 2016–2021, taking into consideration the real financial capabilities and allowing for mid- and long-term planning.

International Operations and Missions

Participation in international operations and missions is an important part of NATO's common tasks. International operations and missions are a place where the SAF can compare itself to its allies in terms of competence as well as equipment and armament.

The SAF's participation in international operations and missions is a direct contribution to regional and global security, as peace in the narrower and wider region also guarantees peace in Slovenia, with the SAF's contribution being great and undeniable. From 1997 until today, approximately 4,700 SAF members have participated in NATO, EU and UN international operations and missions, with the daily average of about 380 members. The first SAF unit participated in the peacekeeping operation ALBA in Albania in 1997, then in Cyprus, in EU operation ALTHEA in Bosnia and Herzegovina, in the UNTSO military observer mission in Syria, in the NATO KFOR operation in Kosovo since 2000, in the NATO ISAF operation in Afghanistan since 2004, in the NATO operation in Iraq, in the UN peacekeeping mission UNIFIL in Lebanon since 2006, in the EU EUFOR operation in Chad in 2008 and

2009, in the naval operation EU NAVFOR Somalia in 2009, in the military observer mission UNSMIS in Syria, in the military operation EUTM Mali in 2012, and in the humanitarian operation MARE NOSTRUM (Lampedusa) in 2013 and 2014. Between October 2015 and March 2016, we participated in operation EUNAVFOR MED/ SOPHIA where our boat TRIGLAV saved or helped to save 1,072 refugees. In September 2016, we will join the operation in Iraq and thus work within the coalition of the willing.

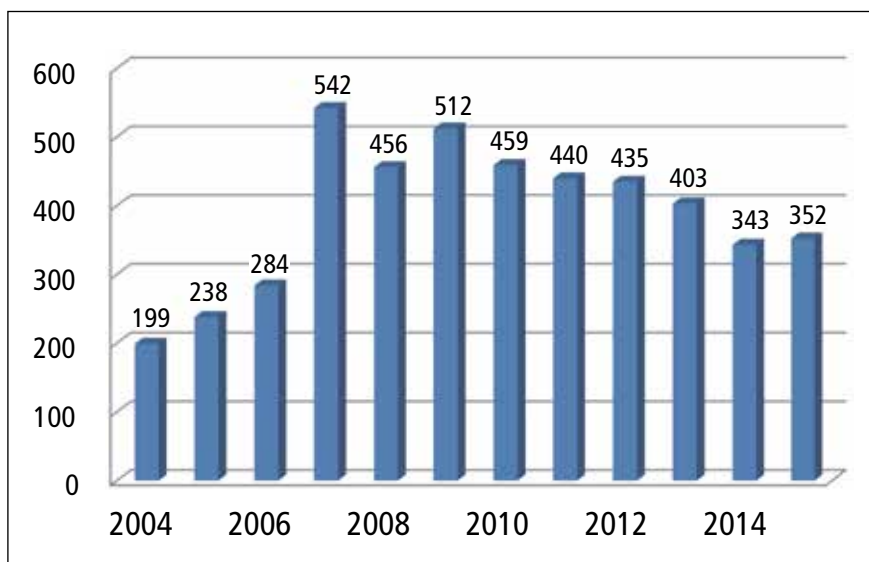
International operations and missions enhance the experience and are a major challenge to most SAF branches and services. The lessons learned through the

system of learning from experience have a direct influence on the preparation of new SAF contingents and SAF development. In 2013, the SAF was faced with a special challenge, which was to prepare the military boat TRIGLAV for participation in the humanitarian operation MARE NOSTRUM in Lampedusa. This was the first deployment of the military boat TRIGLAV to an international operation. Given the total number of SAF members, numbering 7,136 on 14 May 2015, the percentage of SAF participation in international operations and missions is high, which can be seen from the presented graph.

Each new SAF contingent in international operations and missions acquires new and



The SAF has participated in the KFOR operation in Kosovo since 2000.



Source: SAF

Annual SAF participation in international operations and missions.
The data are recorded up to 14 May 2015.

invaluable experiences which are also relevant to NATO and the EU. Each international operation and mission is therefore special and specific.

International Military Exercises

Each international military exercise presents a special challenge to the SAF. The exercises are part of collective training to achieve the required standards, and to maintain and ensure operational readiness. The combat orientation of peacetime training of units and commands allows for the implementation of the expected tasks in real combat situations. Through exercises, an individual is trained to understand his or her relationship within the unit and the fact that the performance of his or her task also supports the overall tasks of the team. Exercises are the highest form of collective training. By participating in NATO exercises, the SAF is meeting the national training objectives and those of NATO's Connected Forces Initiative. In all these years, the SAF has participated in a number of international exercises. Armed forces find a special challenge in the exercises where, at the end of the operational cycle, the units' readiness is tested through the certification process. This is a process in which the use of various methods and examinations helps to determine whether a unit is ready for operation or not. National and NATO certifications are used. In 2012, the SAF participated in 36 exercises, and in 2013 in 31 exercises. We had 45 international exercises in 2014. By participating in international military exercises, the SAF tests its degree of interoperability with the Allied forces. Exercises conducted in the Joint Multinational Readiness Centre

in Hohenfels, Germany, with the participation of different allied troops are of great importance as an example of good practice before deploying SAF contingents to international operations or missions.

In 2014, the international ISAF operation came to an end, and NATO exercises have therefore gained importance. These exercises will include NATO commands and NATO Response Forces. International military exercises are important not only for the SAF, but also for Slovenia, making an active contribution to the development and effectiveness of NATO's military capabilities. In 2016, two major exercises are especially worth mentioning. The first is IMMEDIATE RESPONSE, which will include both NATO and non-NATO countries, and the second is Adriatic Strike, which is important for the development of conditions to start JTAC

training in Slovenia. Military exercises supporting RAP or VJTF are also important and the SAF will continue to support them in the future. In 2016, we sent our troops to participate in the exercise in Bulgaria and Estonia in support of the assurance measures, while in 2017, in line with our commitments taken at the NATO Summit in Warsaw, our platoon will take part in the enhanced forward presence in Latvia.

SAF Transformation Processes

Since joining NATO, the SAF has been subject to constant changes. In some periods, transformation processes were more intense, in others less. But almost no year passed without any organisational changes in the formation structure of units and commands. These transformations were also considered in the findings of the Strategic Defence Review that was prepared in 2009. Major transformational changes were determined by the adoption of the Mid-Term Defence Programme 2016–2020. By transforming the tactical level of command in the first and second phases, which started in 2012 and was completed in 2014, the target organisational structure was established, allowing for the efficient performance of the SAF's tasks. In 2014, the SAF entered the third phase of transformation, where the General Staff of the Slovenian Armed Forces has been transformed. A new concept of logistics operations has been established, and the identification of possible process and functional integration with the administrative part of the Ministry of Defence has been implemented. This phase of transformation has ended with the establishment



SAF relief forces supporting a disaster operation in Bosnia-Herzegovina

of two balanced infantry brigades, as the core of SAF development and operation, and the centralisation of logistics support. In the field of civil-military cooperation and the system of protection and rescue, both infantry brigades are even more spatially positioned.

The SAF entered the year 2016 with a military budget (the military defence programme) of €266 million; in 2015, the military budget amounted to €263.2 million. In line with the Medium-Term Financial Projection based on the draft budget for 2016 and 2017, the Medium-Term Defence Programme 2016–2020 provides for a proportional increase of defence expenditure by 0.04 percent of GDP per year from 2018 to 2020. During the year, defence expenditure will thus grow on average by around €26 million.

The SAF efficiency is also achieved through the rapid response of the command and control system. Irrespective of the reduction of budgetary resources, the SAF will have to maintain and upgrade the already achieved standards in individual and collective competence.

The SAF's transformation is an ongoing process responding to external changes. Looking at the time from Slovenia's entry into NATO until today, the greatest transformational changes were caused by transitioning from a conscript to a professional army, with the development progress of the SAF being very evident. The most important transformation challenge today is that of providing adequate military capabilities to implement tasks in Slovenia and abroad with the available budget funding. The SAF's fundamental future challenge and capability goal for NATO is the establishment of a medium battalion battle group. An important Slovenian contribution to the Alliance is the establishment of the Multinational Centre of Excellence for Mountain Warfare in May 2015, since the majority of NATO countries have already established various centres which are operating successfully today. Slovenia is the co-founder of some of them. We should also not overlook the fact that the SAF plays an important role in its narrow re-

gion, providing mentorship to some other countries in the Balkans that are in the process of integration into the Alliance. Moreover, in the past, the SAF initiated the establishment of Multinational Land Force. International activities also affect the SAF transformation processes, with the provision of military protection and rescue capabilities being at the forefront, which is one of the SAF's tasks. A large part of the equipment at the SAF's disposal thus has a dual purpose.

For the near future, we consider that early announcement of the future Framework Nations or Framework Nation Groupings

is of paramount importance for NRF/VJTF success. To fulfil the "28 for 28" principle, for non-framework nations like Slovenia, and in particular countries with limited resources and availability of military capabilities, the key challenge will be to ensure firm support with appropriate sustainable contribution for the planned NRF three-year cycle. All potential future solutions and emerging concepts must somehow reflect those challenges. Nevertheless, Slovenia will fulfil its commitments arising from the RAP as well as other commitments taken at the NATO Summit in Warsaw. ■



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“Mind the Gap!”

A Review of Strategic Airlift Programmes and Capabilities in European NATO and EU Nations

Georg Mader

Enough has been spoken and printed about how the identity, mission and requirements of NATO have been evolving since the end of the Cold War. We all know that the pace of this evolution in mission sets has been increasing and is heading towards an ever more global and more rapid expeditionary-force character, responding to both conflict and humanitarian needs.

Strategic airlift is a core capability required to be able carry out these endeavours across the globe. While the United States operates a tremendous strategic airlift capability, and the UK and other big NATO players

along three key variables: how much needs to be lifted, over what distance and against what time limits. Comparing current and future aircraft data against scenario requirements reveals if a capability gap exists and

go, which included some of the heaviest and most outsized cargo loads. Following MTM/D calculations and modelling, a significant gap in Europe's current airlift fleet was revealed, while it was anticipated that the future fleet should have adequate capacity. The European current fleet mix of aircraft was only able to produce full force closure in 73.59 days, significantly missing a 30 day NRF-goal. At 5.89 MTM/D the European capability fell far short of the calculated 10.17 MTM/D requirement. Run with a strict 30 day limit, the current European fleet was only capable of moving 56 % of the required cargo. However, when using an (anticipated) full fleet of some 170 European A400Ms quite the opposite results were achieved, with force closure achieved in just 26.08 days. When again restricted to 30 days, it shows that “only” 124 A400Ms were required for force closure for this scenario. It should be noted that these results included Multi-Role Tanker Transport aircraft (MRTT), like the A310, in a supporting cargo role – while in reality these would be likely to transport much of the human element of such an undertaking, so the modelling was compromised.

European military leaders – less so their politicians, talking ESDP – know all that. For reasons following the much-strained and overused set phrase of European ‘global standing’ and parallel changes in US strategic focus shifting between Europe and Asia, everybody involved today says how important it is for the ‘traditional’ European / NATO reliance on US and even Canadian strategic airlift to be mitigated. Several loud statements from both camps of the current US Presidential election campaign have called on Europe along the same lines. But it has not needed presidential hopeful Mr. Trump, to drive European NATO- and PfP-nations to begin to collectively pool resources through multiple initiatives. They had no other chance and no choice and – years ago – being fully aware of the total lack or increasing obsolescence of their (heavy) airlift capacities, NATO- and EU-countries began or joined several projects to sustain their capability to transport troops, outsized equipment and supplies around the globe.



Photo: Mader

In spite of the 174 A400Ms ordered by European customers, European NATO and EU nations are still facing a severe gap in strategic airlift capabilities.

are approaching such – against great odds – other nations lack any substantial airlift assets. Although the imminent-at-last A400M represents a dawn on the horizon, European NATO and EU nations are still facing a severe gap in strategic airlift capabilities. In general, current and future airlift fleet capabilities are determined and quantified

quantifies it as a shortage of X aircraft, Y days, or a figure Z, given in million-ton miles per day (MTM/D). These parameters and variables are physics and are the same for everybody involved in this segment, so for example also valid for the now built-up Chinese force of Y-20 airlifters (like C-17s but with weaker engines).

Author

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

The Gap, Painfully Visible

In a scenario played in 2014 by the US Chief Core Joint Forces Air Component Exercise Branch at Ramstein, the Europeans were tasked with transporting a large NATO response force (NRF) to the area of the Con-



Photo: NSPA

The NATO Airlift Management Agency (NAMA) became part of the new NATO Support and Procurement Agency (NSPA) on 1 July 2012. Shown here is an aerial image of NSPA's Headquarters in Capellen, Luxembourg.

Robust strategic airlift capabilities are vital to ensure that NATO- and EU-members are able to deploy their forces and equipment rapidly to wherever they are needed. By pooling resources, nations also achieve significant savings in time and money, while having the potential of collectively acquiring assets that would be prohibitively expensive if purchased by individual countries via regular acquisition processes.

Merging Coordinator

Back in June 2007, the North Atlantic Council (NAC) approved the charter for a NATO Production and Logistics Organisation (NPLO), which authorized the establishment of the NATO Airlift Management

Organisation (NAMO). It came into effect upon signature of the MoU and notification to the NAC in September 2008. The charter then authorized the establishment of a NATO Airlift Management Agency (NAMA), which acquired, managed and supported airlift assets on behalf of member nations. On 1 July 2012 – in line with the NATO Agencies Reform – NAMO/NAMA became part of the new NATO Support and Procurement Agency, or NSPA.

The true enabling organisation, however, is yet another body, the Movement Coordination Centre Europe, or MCCE, officially established in 2007 to address recognized shortages of strategic lift (not only in the air), by providing a multinational coordinating-body to optimise efficiency across the

full spectrum of movements and transportation. Located at the Eindhoven Military Air Base in the Netherlands – and co-located with the European Air Transport Command (EATC), which manages the missions of some 200 tanker- and transport-aircraft from seven countries – its main purpose in simple terms is to provide cost-saving alternatives for member nations by utilising air-, land- and sea-transport assets owned or leased by national militaries of members or supporting agencies. On 13 June 2007, 15 Nations signed the MCCE Technical Arrangement: Belgium, Canada, Denmark, France, Germany, Hungary, Italy, Latvia, the Netherlands, Norway, Slovenia, Spain, Sweden, Turkey and the United Kingdom. Luxembourg, Estonia and Finland signed in

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Photo: defensie.nl



The European Air Transport Command (EATC) manages the missions of some 200 tanker and transport aircraft from seven countries.

Photo: SALIS



The Strategic Airlift Interim Solution (SALIS) initiative is now a multinational consortium of 18 countries that has contracted a civilian company to charter up to six Antonov An-124-100 heavy transporters.

the autumn of 2007; Poland, Romania and the US in 2008; Austria, Portugal and the Czech Republic in 2010, Croatia in 2011, and Slovakia and Lithuania in 2015. As of now, MCCE has an impressive membership of 27 nations.

How Loads Are Pooled

Behind the military addiction to often re-organise and to change nomenclature and abbreviations, the main mission and purpose of the thousands working and serving in all these bodies remain the same: to pool assets by coordinating airlift requests by member nations, using (spare) airlift capacity and capabilities from other nations. This can be a part load, a dedicated aircraft or a mix of the two. Payment for the airlifts usually runs through the "Air Transport, Air-to-Air-Refuelling and other Exchanges of Services" (ATARES) system. Alternatively, airlift can still be arranged through

an Acquisition Cross Servicing Agreement (ACSA) with agreement with the USA, or as a bilateral agreement between nations. In this segment "smart defence thinking" was anticipated in terms of better use of re-

sources, long before the slogan of "pooling and sharing" became predominant. Simple examples: nation X needs to move cargo, troops or equipment to a specific country, while nation Y might be moving cargo the opposite direction, so the empty leg is offered to nation X via MCCE. A win-win for both nations. Or: MCCE nation X requests a cargo to be moved into a remote location. Nation Y signs a contract with a civil broker and offers the aircraft to nation X. All visibility regarding available empty legs is accessible by all member nations, and quite regularly nations put cargo on these offers, as they are cheaper than an individual full charter aircraft.

SALIS

Two joint strategic airlift initiatives currently aim to provide the Alliance with the reach to project power and influence: the Strategic Airlift Interim Solution (SALIS) initiative and the Strategic Airlift Capability (SAC).

In the light of the well known shortfalls in the Alliance's strategic airlift capabilities and the then late and long-pending deliveries of Airbus A400M aircraft, the first project was named Strategic Airlift Interim Solution. SALIS is now a multinational consortium of 18 countries that has contracted a civilian company to charter up to six of the well-known and proven Antonov An-124-100 RUSLAN (Ukrainian for 'Friendly Giant') heavy transporters. These are certainly no tactical aircraft, especially in terms of required airfield conditions, so direct conversions to / from A400M remain delicate, as the latter can land in much more austere strips than the RUSLANS, which need a 'real' airport.

At the June 2004 Istanbul Summit, defence ministers of 12 NATO countries signed an MoU to achieve an operational airlift capacity for outsized cargo by 2005. In March 2006, the original signatories were joined by Sweden at a special ceremony in Leipzig,



Loading of a Dutch PzH2000 howitzer onto a SAC C-17A GLOBEMASTER

Photo: Mader

which also marked the entry-into-force of the multinational contract. In the meantime Finland and Poland have also joined and the consortium includes 12 NATO nations (Belgium, the Czech Republic, France, Germany, Greece, Hungary, Luxembourg, Norway, Poland, Slovakia, Slovenia and the UK) and two partner nations (Finland and Sweden). The RUSLANS are operated from Leipzig airport in Eastern Germany, under three levels of mission readiness. Two are on part-time charter, two more on six days' notice and another two on nine days' notice to support NATO- and EU-operations. A single An-124-100 can carry up to 120 tonnes of cargo. Based on a limit of 20 days or 800 flying hours per month, the consortia members have committed to using the aircraft for a minimum of 1,800 flying hours/year (for 2016). Additional aircraft types such as Il-76 and the sole existing six-engined An-225 are included in the contract and can be used subject to availability. SALIS member nations have used the Antonovs in the past to transport equipment to and from Afghanistan, deliver aid to the victims of the October 2005 earthquake in Pakistan, or airlift African Union peacekeepers in and out of Darfur. Today, support missions for forces in Afghanistan and Africa are predominant. For 2015, the German Bundeswehr reported that 70% of all airlift was purchased from civilian carriers, with SALIS accounting for half of that, with 4,000 tonnes in 65 lifts. Capabilities are coordinated on a day-to-day basis by the Strategic Airlift Coordination Cell (SACC), which is co-located with the NATO MCCE in Eindhoven. NSPA also manages the SALIS contract, which was re-competed in 2012 and RUSLAN SALIS GmbH (a company established under German law) was awarded a new two-year contract until 2014, later extended until December 2016. What will happen next year is not sure: participating nations have already expressed the urgent need for the continuation of the initiative. As it looks, the Russians with Volga-Dnepr have made a new bid, again via RUSLAN SALIS GmbH, which

was originally a 50/50 Ukrainian-Russian JV of Antonov and Volga-Dnepr. But because of the armed conflict between the two 'relatives' since 2014, things have changed and is likely that Antonov – the design authority for those heavy lifters – might be squeezed out. It also has meanwhile been incorporated into the state armaments-organisation UKROBORONPROM – and for the whole defence sector Kiev has adopted strict sanctions against Russia. [The exact trading status of Antonov is also in question at present – Ed.] Ukrainian sources meanwhile state that for the contract extension from

2017 on the NSPA would suddenly require eight An-124s. This might be only 'lobbying' by Volga-Dnepr, who flies 10 such aircraft while Antonov / Antonov-Airlines have only seven. However, one could compensate with two additional An-124s from Maximus Airlines in the UAE, and the Ukrainians are even offering NATO the sole An-225 for the price of an An-124.

SAC

This is the other of the two complementary initiatives aimed at providing NATO nations

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An NH90 helicopter being loaded onboard an A400M.

and participating partners with strategic airlift capabilities. Although operating “real” military transports, with just three C-17A GLOBEMASTERS the number and total volume available are modest at best. SAC is, however, a great example of how partner nations can collectively run expensive assets that would be out of reach for individual purchase. Especially for smaller and newer members this is a key capability for the Alliance to lift valuable manpower and materiel contributions from them, or to assist them in times of crisis or disaster.

Following intense consultations, a Letter of Intent (LOI) to launch contract negotiations was publicly released by 13 NATO countries on 12 September 2006. In the intervening period, two partners joined the consortium and NATO participation evolved to the current ten NATO members Bulgaria, Estonia, Hungary, Lithuania, the Netherlands, Norway, Poland, Romania, Slovenia and the US and two PfP nations Finland and Sweden. Of particular interest: non-aligned Sweden bought the second-highest number of SAC hours, and also seconded the Vice-Commander.

The aircraft are operated by multinational aircrews under the command of a multinational military structure – the Heavy Airlift Wing (HAW). The HAW is manned by personnel from all twelve participating nations who signed an MoU confirming their participation in SAC to acquire, manage, support and operate the three GLOBEMASTERS. The aircraft operate out of Pápa AB, a former MiG-21/23 base in the west of Hungary. The first aircraft was delivered in July 2009 with the second and third aircraft following in September and October 2009, respectively.

Since then these strategic lift aircraft have been used to meet national requirements, but were and are allocated for NATO, UN or EU missions and for other international purposes. The HAW has flown missions in sup-

port of ISAF and KFOR operations, supplies to Afghanistan and to various peace-keeping missions in Africa, as well as humanitarian disaster-relief to Haiti and Pakistan. Membership remains open to other countries – upon agreement from the consortium members. Many wonder why neighbouring wealthy Austria – for decades a traditional contributor to international missions under UN, EU, and PfP command and since a few years active even in Chad and Mali – has not joined the comfortable location just an hour to the east. As we say in Austria: “Reasons are well assumed behind “neutralistic” while outmoded flinches in Vienna”.

The Endless A400M Story

Although this is about overall capabilities and not about technical details of individual platforms, one cannot do without reflecting the latest developments around the most important European platform for decades to come. 174 A400M aircraft are under acquisition from AIRBUS by seven NATO nations; and after the – finally – increasing rate of arrival in the air forces, some nations will or might adjust their SALIS or SAC requirements. The author believes that this fleet will – once, after a distant IOC – constitute significant efforts, if not the solution to collectively address the persistent airlift deficiencies – if enough of them would arrive at sensible intervals. Germany has ordered 50 of the A400Ms, but deliveries have been delayed as Europe’s largest aerospace company grapples with production delays, and in mid-May prepared investors for a charge to the programme as it tries to fix fresh problems. The German government has urgently pressed Airbus to come up with a precise plan for resolving the problem around cracks in its fuselage that – again – hampers deliveries. Now the manufacturer wants to swap-out airframe components in Germany’s A400Ms, because of the cracks

discovered in a French A400M. But there are also fresh gearbox-glitches on its multinational TP-400 engines – the most powerful turboprops in the West and years back constantly plagued by an unhealthy level of metal shavings found in their oil filters. AIRBUS already warned there could be a “significant cost in repairing the gearbox” – not too encouraging and painfully familiar. But the Europeans are probably bound to the high-wing turboprop just as the USAF is to the F-35 fighter. Until these latest setbacks several nations were reassessing their acquisition plans to try and work out the ideal fleet size. Commercial issues like subsequent compensations or technical “minefields” such as the delicate and also delayed EW/self-defence suite will, however, have to wait for a future, dedicated review.

Conclusion

Please note some numbers of airframes mentioned above: three C-17s, six or eight Antonovs. This while tiny Qatar, for example, is acquiring eight C-17s. Europe, collectively 370 times larger than Qatar, labours under a current strategic airlift shortfall that is more than significant. Given the capabilities and priorities stated by NATO and the EU, a substantial gap exists between what is available and what is desired. If we really are in a new Cold War with Russia, one should compare the scale of what was “usual” back then. During exercise REFORGER (‘Return of Forces to Germany’) in 1978, C-5As and C-141s of the US Military Airlift Command flew 13,000 soldiers across the Atlantic. The 5th Infantry Division from Louisiana, the 4th Infantry Division from Colorado, an Aviation Battalion of combat helicopters from Kentucky, artillery from Oklahoma and a HAWK Battery from Texas. All within 96 hours – and some infantry regiments within 24 hours. It remains to be seen if a projected “2020 fleet” of European aircraft will be out there to meet strategic airlift goals of similar dimensions. Calculations support the case, but do not tell us when – 202X? Or even 203X? Execution of A400M orders would not only help both classes of European nations unify in becoming a targeted global “enabler” and “security generator”, but also allow them to act and operate on their own. Deployments in the future will very probably use multimodal transportation, but the future fleet of European aircraft should – at least – enable the rapid deployment of VJTF and NRF forces and EU Battlegroups. Everything else is a political/ industrial perpetuation of “dwarfing” – absolutely not representative of those nations’ economic and financial possibilities – or by the threats they face. ■

Poland and Defence Modernisation

Miroslav Gyűrösi

In recent years Poland has increasingly invested in its defence inventory and combat capabilities. A technical modernisation programme for the 2013–2022 timeframe was launched in 2012.

This massive and ambitious programme did not prioritise modernisation of existing weapon systems, but rather the acquisition of new weaponry alongside phasing out many older systems – and also continuing to improve and widen the future defence industrial capabilities of the country. It included fourteen separate programmes, each of which is divided into a number of sub-programmes. The process is complicated, sometimes with problems and delays, and in many cases has created difficulties at some organisational levels. All these processes have spawned significant momentum within the Polish defence industry, with many reorganisations and the creation of new industrial and commercial groupings.

The modernisation encompasses programmes to modernise existing weapons systems and to acquire new weaponry, and which are case studies for implementing modernisation programmes with the involvement of local industry. This means involvement in programmes where the country has an existing capability and also acquiring new industrial, technological and production capabilities. And the focus on the involvement of the Polish industry has increased since the latest change of the government. The programme was criticised of late for bad management and insufficient funding, but now a state inspection and audit has clearly shown that the original financial allocation of around PLN100 Bn was insufficient and that at least PLN 230Bn is required. The new Polish government and Ministry of National Defence staff, looking for real capabilities

and considering the necessary financial resources and changed geopolitical situation, are finalising a re-worked programme right now, which will be ready by mid-Sep-

tember 2016, when the key issues will be publicly presented. Poland itself disposes of many interesting and competitive technological and production capabilities (and products, too) and is refining and improving its position on the international defence market step-by-step. The Polish defence industry is unique in many respects because it is able to combine different perspectives when designing weapon systems – knowledge of both Eastern and Western design approaches and in some cases knowledge of the very weapons; and in other cases it is again unique because of working on and proposing solutions which are unattainable or too expensive in the West. But in many critical areas Poland still has not the relevant technological and production knowledge and capabilities and is therefore obliged to acquiring solutions from abroad. Today the

main governmental component in support of the efforts to increase Poland's defence technological and production capabilities is the Polish Armaments Group PGZ (Polska Grupa Zbrojeniowa): Poland will focus on the acquisition of new technologies and military inventory mostly through PGZ. PGZ today includes more than 60 defence and high-technology companies and factories in Poland, and the group is open for co-

Photo: Miroslav Gyűrösi



Prototype of the SCIPIO wheeled IFV which combines the Polish-made ROSOMAK chassis and the Slovak-made TURRA-30 RCWS

tember 2016, when the key issues will be publicly presented.

Poland itself disposes of many interesting and competitive technological and production capabilities (and products, too) and is refining and improving its position on the international defence market step-by-step. The Polish defence industry is unique in many respects because it is able to combine different perspectives when designing weapon systems – knowledge of both Eastern and Western design approaches and in some cases knowledge of the very weapons; and in other cases it is again unique because of working on and proposing solutions which are unattainable or too expensive in the West. But in many critical areas Poland still has not the relevant technological and production knowledge and capabilities and is therefore obliged to acquiring solutions from abroad. Today the

operation with privately-owned companies and with foreign partners, too.

The modernisation programme covers practically every area of weaponry across the military services, from personal weapons to vehicles, tanks and helicopters, air defence missile systems up to ships and submarines. And it also addresses information technology, software and cyber, which are fundamental in today's world.

Generally the modernisation has been allocated to these fourteen programme areas:

- Air defence systems;
- Attack, utility and VIP transport helicopters;
- C4ISR systems integration;
- Armoured troops inventory modernisation;
- Elimination of naval threats;
- Surveillance and reconnaissance;
- TYTAN;

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Photo: Mirosław Gyrósi

POPRAD (left) and KUSZA (right) self-propelled VSHORAD missile systems

- Rocket and artillery troops inventory modernisation;
- Simulators and training devices;
- Advanced jet trainer;
- Transport aircraft;
- ROSOMAK armoured personnel carrier;
- SPIKE ATGM;
- Sentry and guard reconnaissance.

and technical support but not ammunition. Production of the first serial systems should be finalised in the second half of 2017. The delivery schedule envisions 14

Air Defence Systems

No doubt this is the most challenging and widest chapter of all current modernisation efforts in Poland. The biggest challenges include the acquisition of new weapon systems in the scope of three main programmes – the WISLA MRAD system, the NAREW SHORAD system, and the POPRAD VSHORAD system.

Under WISLA Poland is looking to buy 8 missile batteries. At the moment discussions with Raytheon and the MEADS International consortium are under way, but at MOD level an analysis continues about the acquisition of other systems such as SAMP/T, for example.

For NAREW the project definition of tactical/technical requirements and the feasibility study were both finalised last year. Poland plans to acquire 19 missile batteries.

The POPRAD VSHORAD self-propelled system from the Polish Company PIT-RADWAR, was contracted on 16 December 2015. The contract covers production and delivery of 77 SPZR POPRAD (SPZR = Samobieżny Przeciwlotniczy Zestaw Raketowy = Self-Propelled Missile System) in the 2018-2021 period. Valued at PLN1.0835 Bn, the contract covers training

Photo: Mirosław Gyrósi



Automated working places of the second phase of the modernisation of the S-125SC NEWA-SC ADMS guidance radar

systems in 2018, 22 systems in both 2019 and 2020, and the last 19 systems will be delivered in 2021. Ultimately Poland will field 79 SPZR POPRAD systems. The SPZR POPRAD has a rotating remote controlled turret mounted on the Polish-made DZIK-P armoured car. The turret is fitted with the optronics pack and four ready-to-fire combat-proven GROM VSHORAD missiles. In future Poland is looking to arm the

SPZR POPRAD systems with new PIORUN MANPADS missiles.

Work on the modernised PIORUN MANPAD system at the Mesko company is being finalised. Contract discussions could take place before the end of 2016 for delivery of the first serial production launchers (420 pieces) and missiles (1600 pieces). The new PIORUN MANPADS missile should offer longer range, higher precision and higher kill probability than the original GROM MANPAD system.

In recent years Poland has also developed a very interesting light self-propelled VSHORAD system which uses the same GROM/PIORUN missiles. The system, named MSR KUSZA (MSR = Mobilny System Raketowy = Mobile Missile System, KUSZA = Cross-bow) was developed by a small company, Telesystem-Mesko. The folding launcher with an optronic suite and two ready-to-fire GROM missiles is fitted to a Polaris 800 6x6 light three-axle vehicle. The carrier vehicle with weapon system, ammunition and crew weighs just 1100 kg. Today the company proposes this system universally, with the possibility to fit it to any vehicle or any static land platform. In future the

designers are looking to use the more powerful PIORUN VSHORAD missiles

While the Polish industry is unable to develop and produce high-performance missiles, and is forced to look to partners abroad in the area of higher performance missiles, there are some very agile and successful companies in the area of military electronics in Poland. In the development and production of air defence radars and

ESM devices the PIT-RADWAR company, which is part of PGZ, is a good example. This company is working today on many technologies for future radar applications, including for example liquid- and air-cooled T/R modules. Current radar technology programmes include the L-Band T/R module, X-Band T module and T/R module, S-Band T/R module, C-Band T/R module and Ku-Band T/R module.

By the end of 2015 PIT-RADWAR had delivered 8 SOLA mobile SHORAD radars to the Polish Armed Forces. This programme will continue with serial production and deliveries to the Polish customer, with an improved version of the radar and a new AESA antenna unit. The new improved radar, which is in the final developmental phase now, is named BYSTRA. Production and delivery to the Polish Armed Forces of 19 BYSTRA mobile SHORAD radars is planned in the 2018 – 2022 timeframe.

In the area of new developments PIT-RADWAR is working on at least three new air defence radars and one mobile passive air defence ESM system. The radar designs include a mobile 3D long-range radar, mobile SHORAD multifunction radar and mobile early warning VHF radar. The new mobile SHORAD multifunction ra-

dar developed for the future NAREW SHORAD missile system works in C-band and uses an AESA antenna unit. The antenna unit is fitted to a 15m tall mast and rotates mechanically in azimuth while transmitting a digitally-formed beam in both planes. The radar offers multi-beam scanning in elevation and possible operation with a 'pencil' beam. The radar is designed to detect low-flying aerial targets, tactical ballistic targets and hovering helicopters. The complete radar and its components including the folding mast are fitted to a single Jelcz 8x8 truck chassis, offering high mobility and automatic levelling.

The software-defined 3D long-range radar named RDL-45 operates in L-Band and uses distributed solid-state air-cooled T/R modules and an active phased-array antenna unit. The radar design has a fault-tolerant architecture, using advanced "soft-fail" management. Time into and out of action is claimed to be less than one hour. The radar design and capability include IFF Mark XIIA (Mode 5 and S) with a dedicated IFF antenna unit located on top of the main antenna unit, and its own decoy system. The complete RDL-45WA system is transported by two Jelcz 8x8 high-mobility trucks with trailers.

The new AESA early-warning VHF-Band radar is temporarily dubbed P-18PL, and offers an excellent price: efficiency ratio, especially against low observable/ very low observable aerial targets. The design approach offers a digitally-formed beam in both azimuth and elevation and will be able to simultaneously detect air-breathing aerial targets and tactical ballistic aerial targets. The developers have integrated a passive mode capability when one radar acts as the transmitter and a second, remote, radar acts as the receiver. Capability claims against aerial targets with a 1 m² RCS include a slant range of 460 km and a maximum instrumental altitude of 155 km. Against aerial targets of 0.1 m² RCS the declared maximum instrumental slant range is 260 km and maximum instrumental altitude is 90 km. This system is transported on two Jelcz 8x8 chassis.

One particularly interesting air defence development from Poland is the new passive mobile ESM system currently named PET-PCL (Passive Emitter Tracking – Passive Coherent Location). This pioneering development is unique, combining TDOA and PCL technologies in a mobile system. The system comprises four antenna unit vehicles and operates in the 20MHz – 18GHz

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frequency range. The system has three subsystems – COMINT (working range 20 MHz – 6 GHz), ELINT (working range 500 MHz – 18 GHz) and IFF/NAV (detecting IFF signals and DME/TACAN navigation systems). In future the PET-PCL system will allow air defence missile fire units to receive real-time aerial target information in full passive mode.

The Polish defence industry is very active in the modernisation of existing inventory, an example being the second phase of the S-125SC NEWA-SC SHORAD air defence missile system improvement. The S-125SC was developed by WZE (Wojskowe Zakłady Elektroniczne = Military Electronic Works) company in the 1990s, as a fundamental modernisation of the original Soviet S-

SNR-125SCs is carried together with the antenna unit on one MAZ-543M chassis, all the computers and electronics have been replaced, and redesigned workplaces with new and larger displays and new software have been installed. Now the system is fully digitised. The redesigned electronics and new optronics suite allows operators to automatically track targets optically in passive mode (both TV and IR). Today all guidance radar electronics are fitted into two consoles. Visually, the only obvious difference between the original modernised S-125SC system and newly-improved systems is the new ZGO day/night optronic suite (Zintegrowana Glowica Optyczna = Integrated) fitted to the antenna unit. This device includes the optoelectronic head

has a 800x600 pixels resolution and offers 5° WFOV and 1.2° NFOV. The IR thermal camera has a 3.7-4.8 µm cooled matrix and gives 640x512 pixels resolution. This camera offers the same fields of view as the CCD camera.

Helicopters

There are certain helicopter sub-programmes. In September 2015 the CARACAL-POLSKA consortium won the tender to deliver 50 multi-role helicopters, but the signing of the contract is impacted by off-set conditions within the contract itself. As a result the whole contract is delayed. The KRUK attack helicopter sub-programme calls for the future acquisition



Polish industry modernised the ZU-23-2 air defence gun to the variant named PILICA. The Ministry of National Defence is planning to buy six PILICA systems.

125M system. Work started in 2011 and now the Polish Armed Forces have serial modernised systems. The main areas of the second phase of the modernisation are new electronics and improvements to the guidance radar. The information structure of the SNR-125SC has also been changed to a networked structure. Inside the cab, which in the case of modernised

and BSPS control and signal transmission unit. In the lower part of the antenna unit mast the new opto-pneumatic connector is fitted, and in the guidance operator's workplace the VT-13 video tracker card and PRV-13 image recording card are included. The CCD daylight TV camera, IR thermal camera and LRF are located inside the optronic suite box. The CCD daylight camera

of 32 new helicopters. The responsible authorities are now analysing the basic requirement in the context of recent developments in Poland's geopolitical and security environment. In parallel they are also assessing the feasibility of conducting a legal competition, because only one contender meets the defined operational requirements.

C4ISR Systems Integration

The goals of this extensive sub-programme include extension of the command and control capabilities of the Armed Forces across the total mission spectrum to the national automated control system, and battle management systems integration with a functional information system. One of main steps of the programme is to equip the ROSOMAK wheeled IFVs and APCs with the new battle management system.

Armoured Troops Inventory Modernisation

This area also encompasses a wide range of efforts. The main goals of the programme are to replace older technologies with new armoured vehicles created on the basis of a new universal modular tracked platform, and to increase the combat capabilities of the 119 LEOPARD main battle tanks in the current inventory. The LEOPARD 2A4 tanks will be modernised to the new LEOPARD 2PL status by PGZ and the Bumar-Labedy company in close cooperation with strategic partner Rheinmetall Landsysteme from Germany. This modernisation contract is valued at PLN2.145 Bn, and was signed on 28 December 2015. Conversion and improvement of these MBTs should be completed by 2020, and the first modernised LEOPARD 2PL tanks will be delivered to combat units in 2018.

Under the name BORSUK Polish designers are working on a new tracked IFV based on a new universal modular tracked chassis. This design by HUTA STALOWA WOLA is now in the phase of conceptual and technical-economic analyses.

The GEPARD sub-programme of the armoured universal modular tracked chassis is postponed for the moment.

Elimination of Naval Threats

Naval surface ships are mostly being built in local shipyards in close cooperation between Polish and foreign partners.

The building of the SLAZAK Patrol Corvette in the Navy Shipyard has been delayed from the original plan for at least 18 months. The estimated conclusion of this shipbuilding programme is in mid-2018. This has affected plans for building three ships of the CZAPLA Corvette project and three ships of the MIECZNIK Patrol Corvette project in this shipyard. The shipyard is now under management of the PGZ group. The CZAPLA and MIECZNIK projects will most probably merge into a single programme with six identical ships to be built.



Photo: Miroslav Gyürösi

MSBS-5.56K (top) and MSBS-5.56B (bottom) assault rifles

Remontowa Shipbuilding in Gdansk currently works on building the new KORMORAN minesweeper. The contract to build this ship was signed in 2013, and work is running as planned. The ship will be delivered to the Polish Navy by the end of 2016. The modernisation plan looks to acquire three new-generation submarines, which will be armed with cruise missiles. The national authorities are currently analysing possible acquisition methods.

The Navy continues to introduce NSM anti-ship missiles for the second fire division of the coastal anti-ship system: in 2015 Poland received 14 NSM missiles.

Surveillance and Reconnaissance

The main focus of this chapter in the modernisation plan is the acquisition of various classes of UAV systems.

In the MALE class of UAVs (local name ZEFIR) Poland is looking to acquire two systems by 2022 and two additional systems after 2022.

In the category of medium-range tactical drones the country is considering the acquisition of a total of 12 systems.

In the short-range tactical systems category Poland

is looking to acquire 12 systems of a type known as ORLIK and 15 mini-drone systems known as WIZJER.

In the category of miniature VTOL drones for the urban battlespace (named WAZKA) Poland is looking to acquire 15 systems.

Finally, in the micro-drone class there is the planned acquisition of 6 systems.

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In April 2016 the analytical-conceptual analysis phase began for short-range VTOL drones in a programme known as ALBATROS. The acquisition of this type of drones is planned for the period 2019 – 2020.

TYTAN

Poland's Future Soldier Programme is named TYTAN and includes many components. The original contract was awarded in 2014. At this very moment (August 2016) the contract is delayed because of a delay with a new type of radio station which meets current cybersecurity requirements, which means TYTAN as a whole is postponed to 2019.

One of most important components of the TYTAN programme will be the new MSBS-5.56 assault rifle. The MSBS (Modułowy System Broni Strzeleckiej = Firearm Modular System) has been designed by the Polish company FABRYKA BRONI LUCZNIK from Radom for 5.56 mmx45 NATO calibre ammunition. The company developed this weapon in

Rocket and Artillery Troops Inventory Modernisation

In this category there are numerous projects. Key examples include the tracked KR-AB self-propelled 155/52 mm howitzer (the turret has been swapped from the original Polish-developed chassis to the chassis of the K9 SP howitzer developed by Samsung Techwin in South Korea) and the REGINA command and control system. The next project is the RAK self-propelled 120 mm mortar on the chassis of the ROSOMAK wheeled APC. Work continues on the new HOMAR MLRS, but with a change to the lead company, now PGZ.

The KRYL SP 155/52 mm howitzer on a wheeled chassis is delayed by two years. The command vehicle project for the KRYL is also delayed, by one year.

Simulators and Training Devices

This very specific programme chapter includes more than 80 projects covering simulators and training devices. One of the latest

ish Ministry of National Defence are currently in discussion with the manufacturer about the possible delivery of a third aircraft, also in 2016.

Transport Aircraft

This programme, which included both C295M and AN-28 aircraft, is concluded now.

ROSOMAK Armoured Wheeled Vehicle

The local manufacturer continues to work on a version of the vehicle with the new ZSSW-30 remote controlled weapon station, with a 30 mm gun and SPIKE ATGM. The newly ordered SPIKE-LR DUAL is expected to equip the KTO ROSOMAK vehicles on the new ZSSW-30 RCWS.

SPIKE ATGM

The contract to manufacture and deliver 1000 SPIKE-LR DUAL ATGMs with a range of four km and SSC/IIR seeker was signed on 17 December 2015. The missiles will be manufactured locally by Mesko company and will feature a new smokeless rocket motor. The value of this contract is PLN602 M and the missiles will be delivered in the 2017 – 2020 timeframe.

Sentry and Guard Reconnaissance Vehicle

This chapter includes at least two projects. The first is the KLESZCZ, realised by AMZ KUTNO company. This programme is delayed and will probably not be realised before 2020, or maybe even 2021.

The second programme is the ZMIJA long-range reconnaissance vehicle. The Ministry of National Defence needs to acquire 118 vehicles under this project. At the moment two companies (PGZ and PHO) have proposed their solutions to the customer.

Conclusion

As can be seen from the above, the Polish defence industry enjoys a wide range of competencies and expertise, against a background of comprehensive, identified and defined requirements. Once the financial resources have been allocated the Polish market will become even more attractive for international companies looking for customers and partners. In the longer term it will be interesting to see which Polish companies and capabilities prosper on the broader international defence and security markets. ■



Prototype of the 155/52 mm KRYL self-propelled howitzer

two variants – MSBS-5.56K with stock (Kolbowy = with stock) and MSBS-5.56B Bull-Pup design (Bezkolbowy = without stock). Both designs use some common components – for example the 406.4 mm-long barrel is the same for both weapons. The MSBS-5.56K is 900 mm long (the length with folded stock is 670 mm); the height without the plastic ammunition magazine is 195 mm and the width is 82 mm. The MSBS-5.56K weighs 3.65 kg. The MSBS-5.56B Bull-Pup assault rifle is 670 mm long, height without magazine is 215 mm and the width is 82 mm. This weapon weighs 3.55 kg.

realised was the SL MiG-29 FFS/FMS flight simulator in Minsk Mazowiecki Air Base which was handed over to the customer in early June 2016. The simulator was created and delivered as a cooperative venture between the Polish company KenBIT and the Slovak company Virtual Reality Media (VRM). The contract is valued at PLN29.9 M.

Advanced Jet Trainer

This programme was contracted in 2014 for delivery of the M-346 aircraft. The first two aircraft are scheduled for delivery to Poland in 2016. Representatives of the Pol-

Air-to-Air Missile Market Developments

David Saw

There was a time when it was assumed that Western, predominantly US, Air-to-Air Missile (AAM) systems and technology were far in advance of the systems and technology available to any potential competitor. Whilst that might have been true once, it is most certainly no longer the case.

Consequently, the AAM sector of today is characterised by numerous different approaches that are geared to answering the fundamental requirement of being able to accurately and reliably engage hostile targets at desired operational ranges.

It must be understood that we are asking a tremendous amount of the AAM in both Within Visual Range (WVR) and Beyond Visual Range (BVR) applications. A missile must offer the ability to successfully engage highly manoeuvrable targets, providing the most effective no-escape zone to the maximum extent of its range envelope to ensure a satisfactory engagement. The missile must also be able to cope with jamming and other countermeasures. Furthermore BVR systems must feature secure and reliable data-links to allow them to fully maximise their performance.

In the modern era, for our purposes since the early 1990s, there have been significant developments in AAM systems in an effort to achieve the universally desired objectives of increased kill probabilities, extended ranges and resistance to countermeasures. However, these 'significant developments' have not as yet delivered the kill probabilities desired by end users in any consistent fashion. It is all too often the case that the performance figures derived from testing regimes have not translated into the realities of operational conditions. Furthermore, the fact is that recent operational experience in terms of air combat is not that instructive for future AAM developments, especially since such combat has been against inferior air forces who are outmatched in terms of equipment, systems, personnel and training.

As things stand currently, most air forces will retain their existing inventory of weapons for

the foreseeable future and we will discuss these weapons later in this article. However, it is clear that a new generation of weapons is on the verge of entering service. These will feature extended ranges, well in excess of 150 km, and will be expected to operate against peer or near-peer opposition. By that we mean, against opponents operating 'stealth-type' aircraft, with advanced avion-

ics, high level jamming and counter-measures capabilities and having missiles that are equivalent to or near equivalent to friendly weapons. Should this become a reality it will transform any future air battle picture as Western air forces will have to fight for air superiority rather than assuming that air dominance will be theirs by right.

ibre machine guns, it then became apparent that the weight of fire generated by these weapons was insufficient. This saw a transition to heavy machine guns and to cannon. The need to confront heavier and better protected targets saw the development of higher firepower options such as unguided rockets and by 1945 the first modern AAM, the Ruhrstahl X-4, a wire-guided missile system, was ready for deployment. Although gun systems would remain, it became accepted that the future of air combat would belong to rockets, at least initially, and to missiles. In 1946 the US Navy (USN) started work on an AAM that would eventually evolve into the AIM-9 SIDEWINDER, still the standard US WVR system today, while the US Air Force (USAF) started its own



Photo: US Air Force

An F-16 heads for the Grand Bay Bombing Range out of Moody Air Force Base, Georgia, in March 2016. The presence of two AIM-120 AMRAAMs and a single AIM-9 SIDEWINDER reflects the standard air-to-air missile armament of US combat aircraft. There is concern in the US Air Force that they might find themselves outranged by next generation foreign weapons.

ics, high level jamming and counter-measures capabilities and having missiles that are equivalent to or near equivalent to friendly weapons. Should this become a reality it will transform any future air battle picture as Western air forces will have to fight for air superiority rather than assuming that air dominance will be theirs by right.

Beginnings

At the start of World War 2 in 1939 most fighter aircraft were equipped with rifle-cal-

programme that would lead to the Hughes AIM-4 FALCON. Then in 1947 the USN contracted Sperry to develop a guided version of the 127 mm High Velocity Aircraft Rocket (HVAR) that would become the SPARROW 1 and later be designated as the AIM-7A SPARROW. The SPARROW would remain the primary US BVR system until the early 1990s.

The unguided rocket would persist into the 1950s; the last of these systems was the Hughes AIR-2 GENIE that was designed to tackle high flying strategic bombers and had

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a 1.5 kt W25 nuclear warhead! After this point it was clear that the AAM was the key air combat system. As well as the US the then Soviet Union poured vast resources into developing missiles, as did Britain and France. By the end of the 1950s Israel had also started on developing its first AAM: the Rafael SHAFIR.

Into Combat

The AAM was used in combat in September 1958, during the Taiwan Straits Crisis that saw clashes between the People's Liberation Army Air Force (PLAAF) of China and the Republic of China Air Force (ROCAF) of Taiwan. PLAAF were flying MiG-17s, while ROCAF operated the F-86 SABER, but ROCAF also had a number of AIM-9B SIDEWINDER missiles and it used these successfully in combat. There was an exception to this though, one AIM-9B hit a MiG-17 but did not explode and the aircraft returned to China with the missile stuck in its fuselage. The missile would be donated to the Soviet Union and its technology would provide the basis for the Vympel K-13 infrared guided missile.

The early AAMs actually proved to be very disappointing, in Vietnam between 1965 and 1968 AIM-7 SPARROW Beyond Visual Range (BVR) missiles had an 8% success



Photo: US Air Force

A US Air Force F-15 fighter of the 58 Tactical Fighter Squadron on a combat mission during Operation Desert Storm in 1991. The combat load is four AIM-7 SPARROWS on the centreline, plus an AIM-9 SIDEWINDER on the left wing and an AIM-120 AMRAAM on the right wing.

decisive system for air-to-air combat, but technological and tactical advances would change that picture and make the missile the dominant system.

Eventually the US introduced the AIM-7F SPARROW, which had increased range due to an improved motor and increased performance due to solid state electronics. The AIM-7 would also provide the basis for non-US BVR missile programmes, the Alenia (now MBDA) ASPIDE and the BAe Dynamics (now MBDA) SKYFLASH were all developed from the SPARROW. Aspidide would also spawn another missile in the form of the Chinese PL-11. The US consistently improved SPARROW performance, for example the AIM-7M of the 1980s, through to the replacement of the missile by the AIM-120 AMRAAM in the 1990s.

The other important US BVR development was the US Navy AIM-54 PHOENIX. Used by the F-14 TOMCAT with the AN/AWG-9 radar, the PHOENIX offered a long-range engagement capability with ranges in excess of 185 km achieved. The only problem was that this was a very heavy missile, 450 to 470 kg in weight, depending on the variant.

Eastern Promise

During the 1980s the then Soviet Union introduced two new high-performance combat aircraft into service in the form of the MiG-29 and then the Sukhoi Su-27. These new aircraft were accompanied by new missiles in the form of the R-27 family for BVR applications and the R-73 for WVR work. The R-27 was considered to be the Soviet counter to the AIM-7, that actually understates R-27 performance as system variants offered ranges of 72 km out to 130 km. There were some eight different R-27 variants with various semi-active radar homing, active radar homing, infrared homing and anti-radiation seekers.

R-27 production started in 1983 and Vympel (now part of Tactical Missiles Corporation) in Russia still produces the system, which

has been widely export both in the Soviet and post-Soviet periods up to the present day. The missile is also produced by Artem in the Ukraine, who manufacture six different R-27 variants. Poland is to acquire 40 Artem-manufactured R-27R1 semi-active radar homing missiles from a joint venture of WB Electronics of Poland and Spetstechno-export of the Ukraine for its MiG-29 fighter force.

Another Vympel missile that entered service in the 1980s was the R-73 WVR system. The weapon was highly agile and had a high performance seeker linked to a helmet-mounted sight, with 45 degree off-boresight acquisition. Later R-73 variants offered seeker improvements, new fuzes, higher off-boresight capabilities, improved range and an enhanced performance envelope. The R-73 clearly demonstrated that Soviet AAM technology had caught up with that of the West. When the R-73 entered service it was clearly the superior WVR system of that era. The missile has been continuously updated and is now classified as the R-74, with the R-74EM being the latest variant. A further new variant is likely to support to the Sukhoi T-50 PAK-FA.

The combination of the Sukhoi Su-27 with the R-27 and R-73 offered the then Soviet Union a serious air dominance platform. The idea was to exploit the extended range of the R-27 and then launch large numbers of missiles, mixing different seeker options, to complicate the countermeasures task of the targets. The Su-27 is a big aircraft and it can carry a large number of BVR missiles, thus subsequent multiple weapon launches were possible and then, if required, the aircraft could get in close to use the superior capabilities of the R-73 allied to its own high manoeuvrability in WVR engagements.

All of a sudden the Soviet Union became a totally different proposition in AAM terms. But as the R-27 and the R-73 entered service, work had already started at Vympel on a next generation BVR system that would emerge in 1994 as the R-77. This weapon



Photo: Stefan Kalm/Saab

A Swedish Air Force JAS 39C GRIPEN demonstrating its combat load options. In terms of air-to-air missiles, this aircraft is carrying the Diehl Defence IRIS-T and the MBDA METEOR long-range missile that is on the verge of entering service.

rate, pre-conflict it had been believed that they would have a 71% success rate. As for the AIM-9 SIDEWINDER, the actual success rate was 15% compared to the predicted 65%. At this point the gun was still the

would be exported as part of MiG-29 and Sukhoi Su-27/-30 sales, while the Russian Air Force appeared to have opted for the extended range (around 110 km) R-77-1 variant. This weapon is seen as the Russian equivalent of the AIM-120 AMRAAM and is certainly competitive with the US system. Upgraded R-77 variants are in development featuring an improved seeker and increased range, there is also a ramjet-equipped variant, and it is anticipated that both will be employed by the next generation T-50 fighter.

Also worthy of mention are the long-range missile systems linked to the MiG-31 interceptor, the initial R-33 missile variant (120 km range) entered service in the early 1980s, with ranges being increased as new variants entered service. The missile was designed to be used against bombers and manned reconnaissance systems. Then in the early 1980s, the R-37 missile was developed on the basis of the R-33. The objective of this weapon was to target AWACS and other high value platforms from outside of the range of defending aircraft and their weapons. An R-37 test shot in 1994 demonstrated a successful engagement at 304 km. Also in the 1990s, Novator was promoting their long-range (around 200 km) R-127 system, with the target being AWACS type aircraft.

Different Futures

The major advances in Soviet AAM technology only became known to the West after German reunification and the collapse of the Soviet Union, and they would have an impact on Western AAM developments and arguably continuing Russian AAM development activity has acted as one of the major catalysts for ongoing Western AAM investment. Independent of Soviet developments in the 1980s, there was a programme to replace the SPARROW and SIDEWINDER with a new generation of missiles in the 1990s. This would result in the US developing the AIM-120 AMRAAM for the BVR application, while Europe (UK, Germany, Canada and Norway) would develop the WVR SIDEWINDER replacement.

While the AMRAAM, currently in the AIM-120D version, would go on to become the predominant Western BVR missile, in the WVR segment finding a single solution was impossible. Thus Germany went on to develop the Diehl Defence IRIS-T, while the British would develop and field the MBDA ASRAAM. The US would eventually adopt the indigenous AIM-9X for its WVR requirement, although it did look at the Israeli PYTHON and the ASRAAM as alternative solutions.



Photo: MBDA

An image from the MBDA METEOR test programme. METEOR will provide operators of the Eurofighter TYPHOON, GRIPEN, RAFALE and eventually the JOINT STRIKE FIGHTER (JSF) with a unique extended-range air combat capability. Japan is very interested in METEOR, seeing it as a counter to Chinese long-range air-to-air missile developments.

The US had looked beyond AIM-9X and AIM-120 at potential successor systems, indeed in the 1990s the Dual Range Missile was funded under the Air Superiority Missile Technology (ASMT) effort with the aim of having a new missile in service in 2010. Efforts to develop new missiles come to naught, and so for the foreseeable future the US will be dependent on the AIM-9X, currently in the Block II version featuring a lock-on-after-launch capability and a data-link to support BVR engagements, and the AIM-120. The proliferation of high performance long range BVR systems is an increasing concern for the US, indicating a need for a significant AIM-120 upgrade in the near-term.

It is significant that, despite access to the majority of US air weapons, Israel continues to sustain its own missile capabilities. As previously noted Rafael started developing the SHAFRIR in 1959, this was followed by the SHAFRIR 2 and then by the PYTHON 3 in the 1980s. Then came PYTHON 4 in the 1990s and this was followed by the PYTHON 5, which represents one of the most effective current WVR capabilities. Rafael also has a BVR system in the form of the Derby, with an extended range variant (100 km) revealed in early 2015.

France has been following its own AAM path since the early 1950s, with the MBDA MICA system, available in both active radar and infrared homing variants, as its primary BVR weapon. There are now suggestions that a MICA successor is in development, although it remains unclear whether this will be an incremental upgrade or a completely new system. France is a partner in the MBDA METEOR missile programme that will cover long-range requirements, all of which makes French objectives for its MICA upgrade/successor somewhat intriguing.

It is the MBDA METEOR that is arguably the most significant European missile development of the current era. On July 11 it was announced that the system had achieved Initial Operational Capability with the Swedish Air Force on the GRIPEN C/D platform. Other partners in the METEOR programme

are France, Germany, Italy, Spain and the UK, who will use the missile with the EUROFIGHTER TYPHOON, F-35 and RAFALE. This ramjet powered missile will provide European air forces with a unique long-range missile capability. METEOR also forms the basis of an Anglo-Japanese programme where a Japanese seeker is integrated with the METEOR airframe. A distinct Japanese version of METEOR is increasingly likely, with one of the drivers being Chinese long-range AAM developments.

China had lagged behind in AAM technology, but this is no longer the case thanks to the acquisition (not always legitimately) of missiles and missile technology from Europe, Israel, Russia and the Ukraine, amongst others. China's growing AAM maturity was demonstrated by the service entry of the indigenous Luoyang PL-12 BVR missile in 2007, this weapon is believed to have performance levels equivalent to the AIM-120. On 15 September 2015 China successfully tested the Luoyang PL-15, an extended-range missile with ramjet propulsion and a jam-resistant data-link, credited with a range of 150-200 km by the US military. Although the PL-15 is still in development, its capabilities are already of great concern to the US, further increasing the clamour for AIM-120 enhancements.

In the BVR sector it is plain that the future belongs to ramjet powered missiles, with jam-resistant data-links and advanced seekers that have the energy to successfully deal with targets right to the edge of their extended range envelope. METEOR is ahead in the race, but Russia and China are close behind. As regards the WVR sector, extended ranges, lock-on-after-launch, data-links and an increased operational envelope will continue to be key drivers. It is likely that Russia will introduce an R-74 replacement in the near-term and that will provide a true insight into the future of the WVR sector. What is fascinating is how the US will react to being in a potentially inferior position in the BVR sector due to developments in Russia and China. Added to which a new WVR competitor will further add to US concerns. ■

Protected Logistic Vehicles

Gerhard Heimig

The crews of logistics trucks on operations are frequently exposed to the same threats as combat troops. That is why logistics vehicles capable of protecting their crews against hostile assaults have come out on top in missions.

Logistics forces need to be allocated in a way that they meet the requirements of operating forces in terms of command capabilities, responsiveness, flexibility, mobility, sustainability, survivability, and protection. Logistics vehicles need only to be armoured if they are likely to come under enemy fire. In armoured logistics vehicles, protecting the crews takes precedence over protecting the cargo. Another crucial consideration is self-protection – weapon stations that can be operated and, if neces-

sary, loaded under protection. Additional protective equipment always reduces the available payload capacity.

Lessons learned in missions, the analysis of future threats and risks as well as the progress in protective technology are factors pushing the advancement of armoured vehicles. By trading off vehicle weight/payload, protection and functionality against each other, the user requirements determine how the advantages of innovative technologies should be exploited. Modern protective technology is tending to become

way, they benefit from concepts and components tried and tested in continuous operation. The most frequent military adaptations include, among others, colour schemes, the 24-volt-network with jumper socket, blackout lighting, sealing of drive and chassis for journeys across difficult terrain, as well as brackets for hand-held and anti-aircraft weapons and special equipment.

Protective Technologies

Special driver's cabs are needed to protect the crews. Today the industry offers cabs prepared for "add-on protection packages" containing a reinforced frame as well as adapted hinges and brackets. In any case, the chassis with suspension/shock absorbers and cab anchoring points has to accept higher loads. A high-protection driver's cab adds up to three additional tons of weight onto the front axles. This occasionally requires permissible axle loads of as many as eleven tons.

Special manufacturers produce the body of cabs with integrated protection as a monocoque from materials with highly protective properties. Their production requires special know-how both in handling the special materials and particularly for the bending and joining (welding) processes. The semi-finished cabin body features anchoring points for add-on protective elements and partly pre-installed cables that could only be fitted with great effort at a later stage. It is then forwarded to the system manufacturer who completes the cabin interior and fits the protection packages to implement the respectively required military protection level.

The demands on protection have considerably increased in the last few years – also in view of multiple threats. Yet higher protection levels cannot be achieved by simply adding additional armoured elements. Even the latest state-of-the-art materials available today would exceed the tactical weight limits of the platforms. In the absence of significant improvements in material properties, alternative approaches need to be examined to improve crew protection without substantially affecting mobility. It is therefore necessary to consider armouring as early as in the concept phase of the vehicle design – especially with respect to hull/cabin – for a favourable cabin



Photo: Heimig

Scania P440 tractor unit with a tanker trailer during a live demonstration at Eurosatory 2016

sary, loaded under protection. Additional protective equipment always reduces the available payload capacity. This means that logistics vehicles need fittings and equipment that afford them a similar degree of protection to that afforded the troops they are supporting. In order to perform their duties, logistics vehicles therefore basically need the same

more lightweight, with the affect that maintaining the vehicle weight enables a higher protection level while retaining the protection level, or retaining the protection level allows additional mission-relevant payload to be accommodated. Military logistics vehicles are usually based on commercial line production vehicles adapted to military requirements. In this



Photo: Heining

TRAKKER 6x6 with a Euro 6 engine.

design enables the majority of any ballistic and mine blast energy to be channelled off or absorbed.

Cabins with integrated armour are heavy and expensive and needlessly suffer wear and tear when operated under peacetime conditions. Here, one solution is to swap cabins, allowing vehicles to be operated with either an armoured or a soft-skinned cabin, as directed by requirements and threats. The cabin can be exchanged in the field within a day. However, this requires the chassis to be pre-fitted with an adequately reinforced suspension system and cab anchoring points. Retrofitting is virtually impossible, as experiences showed in the 1990s when armoured elements were subsequently attached to soft-skinned trucks. Many manufacturers presented their latest products at Eurosatory 2016. What follows is a description of typical examples for logistics vehicles with armoured cabins. The vehicles are presented as representatives of a production series. This selection of vehicles and manufacturers (in alphabetical order) largely covers the whole spectrum of protected logistic vehicles.

Iveco TRAKKER

The Iveco TRAKKER range trucks are designed to have the protection and mobility to meet demanding specialist military logistic applications. They are available in a large number of variants on two, three, four or even five axles, and can be fitted with an armoured cab.

The new TRAKKER 6x6 Euro 6 is fully compatible with military single fuel operations while still receiving full civilian road approval. The truck is equipped with an FPT Industrial Cursor engine with "HI-eSCR"

emissions management technology. This delivers optimised combustion and post-combustion systems to retain maximum vehicle fuel economy, combined with reduced environmental impact.

The armoured cabin is supplied by KMW. Made of armoured steel, it provides protection against ballistic threats and mines in accordance with STANAG 4569. It also offers protection against IED blasts and fragments. The same cabin type is used on all TRAKKER vehicles and can quickly be substituted by a non-armoured cabin (or vice versa) in the field. The cabin includes all the reinforcements and adaptations needed to safely attach the considerable extra weight of the armour to the connecting elements on the frame. The internal equipment is largely identical to that in the unprotected cabs and the control panel is exactly the same in both. This eliminates the need for training on different vehicle types, at least for operating them when driving.

In addition to the Euro 6 advantages, the vehicle represents the latest evolution of the off-road TRAKKER range. It matches robustness with enhanced driver comfort. An efficient air-conditioning system and excellent soundproofing offer the driver a comfortable and safe driving experience, even under adverse conditions.

Protected TRAKKERs Meet Military Requirements

Iveco Defence Vehicles is one of the premier manufacturers of military trucks in Europe, offering an outstanding product range designed to meet the full spectrum of operational roles demanded by the military user. With more than 70 years of experience of designing and manufacturing both logistic and armoured vehicles, Iveco has an extraordinary depth and width of engineering expertise which is continuously refreshed and updated through feedback from operations and from the marketplace. The result is one of the most technically advanced, reliable and maintainable product ranges in the world. From adaptable light trucks starting at 5.5 tonnes GVW, to rugged 48-ton 8-wheelers with the heaviest recovery cranes, the Iveco Defence Vehicles range is built with the needs of the military user in mind. This product range can be readily customized to match specific user needs by virtue of its modular design, which embraces the cab, the driveline, the protection levels, the EMC requirements, the fording levels, the transmission types and the engine ratings.

Thanks to the close relationship with our customers, in addition to our Euro 3 traditional engine ratings we have developed a wide range of Euro 5 applications with military fuel capabilities with highly protected and non-protected cabs. At Eurosatory, Iveco Defence Vehicles presented its new TRAKKER benefitting from Euro 6 technology compatible with single fuel military operations and offering many customer advantages, including reduced TCO.

The predominant use of the trucks range in critical international scenarios has set new standards of requirements which were in the past mainly linked to more tactical platforms. The most significant ones to be mentioned are for example the radio and jamming systems integration and the adoption of heavy protected cabs against ballistic, blast and IED threats which required the front suspensions and steering systems to be upgraded.

Customers are looking for modularity, ease of use and low costs of ownership. This will be achievable through vehicle solutions which will be capable of maximising the synergies between in-land and in-theatre use.

Italy, France, Spain and Germany are the markets where we are most active today. For the near future, our target is to focus on the EMEA region and to keep on developing our sales in Asia Pacific and South America. In South America, in particular, Iveco Defence Vehicles positions itself already as one of the major market players.

Source: Iveco Defence Vehicles, Bolzano, Italy

With the new 16-speed EuroTronic 2, a fully automatic gearbox system with optional Intarder, the next generation ADM-2 (automatic drivetrain and differential lock management), 14.00 run-flat-tyres and best-in-class general driveability the driver can fully concentrate on road and load.

Further options include new 10-t front axles for load-sensitive bodywork applications such as heavy cranes and for other high-protection cabin variants. Also available are new features such as the modular aluminium roof rack system providing additional storage volume for items like camouflage nets and a new seating configuration with 3-pt-belts approved for 100 kg. This new TRAKKER is part of a new truck generation (frame contract) awarded by the Swiss Armed Forces including 4x2, 4x4, 6x2, 6x6, 8x6, and 8x8 versions in different configurations.

At the end of 2015, the Bundeswehr awarded a contract to Iveco Defence Vehicles for the delivery of 133 armoured TRAKKER 8x8 trucks in the period of 2016

cranes for the recovery of military vehicles, fuel tankers and load handling systems. The High Mobility 8x8 Tractor for example offers power, mobility, manoeuvrability and reliability.

A specially designed cab will allow the integration of appliqué opaque and transparent armour to provide ballistic and IED protection, which can be mounted or dismounted while deployed on operations. This is complemented by an anti-mine kit that can also be fitted in the field. Taken as a whole, this approach enables protection to be tailored to the anticipated threat while facilitating repairs and allowing technological upgrades to avoid obsolescence.

Jelzc P882D

The all-wheel drive Jelzc P882D is one of the heaviest four-axle vehicles of the Polish military automotive manufacturer Jelzc, a company of PGZ Polska Grupa Zbrojeniowa. It is a carrier vehicle designed for a

with anchoring points for 20-ft-containers. The overall weight, including a military payload of 15.5 tons, amounts to 32 tons.

The two-seater cabin features ballistic and mine blast protection certified according to STANAG 4569. The respective level is adjusted to the military requirements. Front and side windshields are made of transparent armour. A roof hatch is used for manual air supply and serves as emergency exit. The cabin can be hydraulically tilted for servicing purposes.

The vehicle additionally features an engine-independent heating and air-conditioning system and a coolant preheater.

Moreover, has one of the major suppliers for the Polish armed forces, Jelz produces trucks and chassis ranging from the 4x4-model 442.32 (with 32 as one tenth of the installed engine performance in hp) and the (6x6) P662D.35 and P662D.43 six wheelers to the most powerful (8x8) P882.53 eight-wheeler.

Mercedes-Benz ZETROS

Among the state-of-the-art all-terrain vehicles, bonnet vehicles like the ZETROS of Mercedes-Benz – specially designed for operation on heavy terrain – are extremely rare. Drivetrain and chassis come from Actros and Axor; the bonnet cabin is a new development. The driver's cabin is arranged lower than usual behind the front axle and puts less weight on the axle. This is especially important with heavy protected cabs. Apart from providing an advantageous axle load distribution, the low overall height enables vehicle transport by air (min. C-130 Hercules) and rail. The crew in the armoured cabin is protected against shelling, mine and IED blasts at a high level according to STANAG 4569. Additional protective features include a CBRN overpressure protection system and pre-fitted mountings for a remote-controlled weapon station. There is enough space for communication devices, personal equipment or an optional third seat. The cabin can be supplemented by a remote-controlled weapon station for the crew's self-protection.

The swap cabin system for the ZETROS presented in 2011 allows the expensive and heavy protected cabin to be substituted with a soft-skinned cabin for peacetime operation. If the base vehicle is equipped with adapted suspension and reinforced anchoring points for the cabin, the service personnel can exchange the soft-skinned for an armoured cabin in a short space of time.

The ZETROS is driven by a six-cylinder in-line engine providing 240 kW and a maximum torque of 1,300 Nm. Its 9-speed



Photo: Jelzc

Jelzc P882D.53 with a two-seater cabin and special body

to 2019. Over the last decade, Iveco Defence Vehicles has supplied from its wide product range some 1,000 vehicles to the German Army and more than 1,200 vehicles to the Swiss Army.

High Mobility Range

Coming from production sites in Italy, the High Mobility range is deployed with the Italian, French, Belgian and most recently the Spanish armed forces. Technologies used with this brand of trucks are largely identical to the TRAKKER range. The range includes 4x4, 6x6 and 8x8 vehicles in different configurations, equipped with various types of demountable hook-lift body work,

number of special applications. It is driven by an Iveco FPT Cursor 10 Euro 3 diesel engine generating 316 kW (P882D.43) or 389 kW (P882D.53), respectively. A synchronised mechanical ZF 16S 221 16-speed gearbox with power take-off (PTO) transfers the propulsive force via inter-axle and inter-wheel differential locks to 14.00 R20 tyres. Maximum speed is limited to 85 km/h. The tyre pressure can be adapted to the tractive force variations on different terrain surfaces by way of a Central Tyre Inflation System (CTIS).

The chassis is designed for the transportation of hazardous materials in accordance with ADR rules and by default equipped



Photo: Daimler

ZETROS 6x6 by Mercedes-Benz, the only protected bonnet vehicle with a loading bed.

gearbox and large 14.00 R 20 tyres provide the vehicle not only with a high tractive force on rough terrain but also enable a top speed on roads of more than 80 km/h. The exhaust values comply with the Euro 5 standard (optionally Euro 3). The permanent all-wheel-drive can be adjusted to terrain conditions by locking the longitudinal and transverse differentials. A bend-proof and torsion-flexible frame of open C-profiles carries the suspension system and the axle control elements are designed for long spring deflections and high driver comfort. The ZETROS two-axle variant is designed for the military 5-t-class payload while it can be operated in the 7-t-class when equipped with the rear twin-axle.

The protected cabin is manufactured by Indikar in accordance with Mercedes specifications while Mercedes performs the completion of the interior and the final assembly. The armoured cabin only slightly alters the outer appearance of the ZETROS. The control panel is identical to that of the soft-skinned variant. The protected 4x4 and 6x6 ZETROS variants can be configured for five or nine tons of payload, respectively. The 6x6 variant is also available as traction unit for heavy trailers.

By 2014, the Bundeswehr had received a first batch of 110 ZETROS armoured transport vehicles, each with a military payload of five tons; some of them were initially deployed to Afghanistan.

ACTROS

The four-axle (8x8) highly off-road-capable Armoured ACTROS of Mercedes-Benz is based on the successful ACTROS production series of which more than 500,000

units are operated worldwide, particularly on difficult construction sites. For the ACTROS 8x8, Mercedes-Benz offers a whole family of protected driver's cabs in different lengths – short, medium, long – and with different armour options against ballistic threats, mines and IEDs.

The ACTROS featuring an armoured cabin is configured for a payload of 15 tons. The ACTROS 8x8 also forms the basis for the BISON armoured heavy support vehicle system, twelve of which were delivered to the Bundeswehr in December 2011.

Oshkosh HEMTT A4

The Heavy Expanded Mobility Tactical Truck (HEMTT) is a member of the fam-

ily of Heavy Tactical Vehicles (FHTV) of the US Army and is said to be the workhorse of Army combat divisions with more than 27,000 pieces since 1982. The 11-ton, eight-wheel-drive vehicle family is designed to operate in any climatic condition. The current version is the A4 with a running production of new vehicles and concurrent recapitalisation of used ones.

The HEMTT has been designed from scratch as a military vehicle – by using military of the shelf (MOTS) components. The basis of the four-axle vehicle is a frame of 9.5-mm-thick manganese steel with high yield strength. Highly robust bolts (grade 8) are used to fix struts and components. The frame is pre-fitted for the installation of an auxiliary pulling winch.

The cabin consists of welded high-performance steel with an anti-corrosion coating and sits two people. It is by default fitted with an armoured floor. Protection of the cabin follows the Long-Term Armor Strategy (LTAS) published in 2006, demanding a modular concept of A-kits and B-kits. A-kits provide a basic level of protection. With B-kits, protection can be tailored to the threat using add-on armour. C-kit armour appeared later but has not officially been defined.

The driving unit is a 515 hp (384 kW) Caterpillar C15 diesel engine that, together with an automatic Allison five-speed gearbox, provides the needed mobility on difficult terrain and a top speed of 100 km/h on roads.

Numerous variants have been implemented. 10-ton cargo transporters with a materiel handling crane, fuel tankers with a capacity of 2,500 gallons (9.5 m³), tractor units, transporters for palletized load handling systems (PLS) and recovery vehicles.

Photo: Oshkosh



Oshkosh HEMTT A4 container carrier version

The HEMTT A3 is a special variant with which, among others, the diesel-electric Propulse hybrid drive for trucks was tested. By using a simplified drivetrain, smart engine control and regenerative brakes, the fuel consumption could be decreased by 20 per cent. Moreover, the vehicle is suitable as a mobile supplier of 120 kW of electric energy to operate e.g. an airfield or a medical facility.

Renault Trucks Defense KERAX

Renault Trucks Defense is part of the Volvo Group and unites the major French vehicle

All models are fitted with the Renault Euro 3/Euro 5 emissions-compliant six-cylinder common rail diesel engine with a power output ranging from 194 to 303 kW. Two-, three- and four-axle chassis are available in a variety of drive configurations. The standard gearbox is the 16-speed ZF 16S 2520 TO that can be replaced by an Allison 4500 SP automatic gearbox. Its maximum speed is 110 km/h.

The all-steel cab can be based around either civilian day or sleeper cabs and will accept appliqué armour panels. Alternatively, the entire cab can be removed and be substituted by a purpose-designed four-seat armoured cab in around four hours' time.

Options for this cab include armour against 12.7 mm AT grenades and anti-personnel and blast-effect mines.

An air-transportable version of this cab is also available that, like the armoured cab, can be fitted to all KERAX models. Basically similar to the series cab, the air-transportable cab has been redesigned to include removable and folding elements that enable transportation in C-130 aircraft and on railway flat wagons.

Rheinmetall MAN Military Vehicles (RMMV)

The HX2 (high mobility) series, based on the civilian TG series, is becoming the new RMMV-standard for heavy-duty, highly mobile all-terrain-trucks. The reliability comes from tried and tested mass-produced components, complemented by innovative technology for military vehicles. The range includes 4x4-trucks with 6 t of military payload, 6x6 (10 t), 8x8 (16.5 t) and 10x10 with 28 t of payload. Depending on the configuration, Euro 6 and Euro 5 standard motors are available with outputs between 240 kW and 400 kW and torques between 1,250 Nm and 2,500 Nm.

The 9-t-axle transmits weight and steering forces both on and off roads. To ensure full steering capability even at top axle loads of eleven tons – which are reached off-road – the front axle has a second steering cylinder on the other side of the frame. The steering force is transmitted through coupling rods attached to the second front axle.

Photo: Heiming



Renault's KERAX with PLS body and laden flat rack

manufacturers in one company. ACMAT and Renault cover the production of logistics trucks.

The KERAX family is based on commercial vehicles which have been adapted to military requirements. These vehicles benefit from the low life-cycle costs of the civilian versions and can be adapted efficiently for large cargo capacities and a variety of different assembly designs. For example, they can have improved off-road mobility, be air-transportable or be fitted with an armoured cabin. The cargo variants are designed for payloads ranging from 10 to 24 t, and some of them feature all-wheel drive. The KERAX can also be extensively modified for tactical missions with improved off-road capacity and air transportability.

The KERAX 8x8 is a rigid logistics or tactical truck available with an armoured cab and self-defence weapon system. The front twin-axes provide a narrow turning radius and high performance with superior driving comfort.



RMMV's HX2 prepared for container transport

Photo: Heiming

HX2 Ready for the Market

Regarding the truck business RMMV exhibited the HX2 8x8 and 4x4 with and without armoured cab. We took the occasion to introduce to the present the HX2 as novelty. This project started some years ago and now became live, while production started and the vehicle is ready for the market.

The family of HX2 consists of variants with 4x4 to 10x10 running gears. All configurations are possible, from cargo variant to recovery or tank transporter. An armoured cab (modular or integrated) can also be offered.

In broad terms RMMV sees great opportunities starting from the European market. The need of quality, performances, survivability, competence on integration (from C4I to any complex superstructure) together with a long term support partnership allows RMMV to play a leading role. We should not forget Australia which is a key customer and other regions where we are historically present.

RMMV is more and more aiming global markets within the Rheinmetall group strategy and synergies. The truck military market has evolved in the last years and new players and segments are now on the scene around the world. The strategy of RMMV is based on fundamental leading technology which differentiates our offers in all aspects, from the product to the through life support.

Source: Flavio Marchesoni, Senior Vice President Sales Military Trucks, RMMV

The low-torsion ladder frame of the HX2 minimises lateral accelerations at the body by its riveted and bolted cross-members and one steel bumper. Its roll-stable drive-ability is supported by the tried and tested leaf spring suspension system that also comes from the trusted line production and was further optimised for the HX2.

The HX-series is protected either by a Modular Armoured Cabin (MAC) or – in case of increased protection requirements – by an Integrated Armoured Cabin (IAC). The standard MAC-kit consists of modules

that are adaptively bolted to the cabin. Installation of the MAC takes only six to eight hours, and can be performed by two trained technicians with the help of a lifting device. Transparent armour and special gaskets complement the package to achieve an economic medium protection level according to STANAG 4569.

The Integrated Armoured Cabin (IAC) as driver's cab in all-steel design provides reliable high protection according to STANAG 4569 against shelling, fragments, AT blast mines, IEDs and lateral blasts. These ar-

moured cabins – developed, among others, in cooperation with Rheinmetall – have proven their protective capability in relevant tests. Active protection is optionally available, as was demonstrated with a sample installation of the Active Defense System (ADS). To enable the crew to respond adequately to assaults, this protected cabin can be equipped with a weapon station operable under protection. HX2 vehicles are supplied for the load class from 5 t to 25 t. The trusted HX series providing highest mobility on most difficult terrain was further advanced to the HX2 in conjunction with the delivery order for about 2,500 trucks to Australia. Chassis and drivetrain were carefully reworked. The new steering system for two controlled front axles was integrated, which improves the handling, particularly of vehicles with an Integrated Armour Cabin (IAC), and supports precise steering even under difficult conditions.

The HX family already forms the core of a fleet of high-mobility, globally deployable transport vehicles. Among others, current user nations include the United Kingdom, Denmark and New Zealand. Australia, Sweden and Norway have also placed large orders with RMMV.

SX Series

Vehicles in the SX series are renowned for their extreme mobility; they distinguish themselves with their extremely good off-road performance which is sometimes as

The **TYRON** range of runflats



Tyron Multi Band - the low cost, short distance runflat system. Approved by NATO and used by the MOD.



Tyron R4 - Double beadlock wheel and runflat systems for 4 x 4 and armoured vehicles.

The World's only multi-piece **RUBBER** runflat with built-in lubrication gel.... Requires no special tools..... Installed in minutes

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good as that of tracked vehicles. Like in the HX, the crew of the SX is protected by an Integrated Armoured Cabin (IAC). SX series vehicles come with three or four axles, making them suitable for missions that require moving payloads between 9 and 15 t on difficult terrain.

Scania P 440

Scania P 440 C defence vehicles with armoured cabs are – like all defence solutions of Scania – based on robust civilian trucks. P

The 13-litre in-line six-cylinder (Euro 5) engine is rated 324 kW (440 hp) and provides a torque of 2,300 Nm. Using the automatic Opticruise gearbox with automated clutch the power is directed via differentials to the driven axles fitted with 295/80 R22.5 tyres. The F958 heavy-duty pressed steel frame provides maximum accessibility for servicing.

All Scania cabs are built with great attention to detail. Everything is in sight, within reach, and easy to control. In military applications these basic features are vital for

ballistic and blast (mines and IED) threats and is prepared to carry a weapon system for convoy protection on its top.

In July 2016, the last of 31 tanker trucks with the P440 CA as tractor unit was supplied to the French Army. The armoured cabin allows the 44-t juggernaut, with its 22-m³ fuel load, to move directly to the most forward combat vehicles. The armoured cab of Essone Sécurité provides protection level 2B and is ready for the integration of IED jammers. It also features a protective grating against rocket-propelled grenades (e.g. RPG 7). Self-protection is provided by a Kongsberg remote-controlled weapon station fitted with a 12.7 mm heavy machine gun.

Tatra T815-7T

The Tatra 8x8 High Mobility Heavy Duty Tactical Truck is a member of the Tatra Force heavy-duty vehicle family designed for rough terrain as well as difficult climatic and environmental conditions. The 8x8 all-wheel drive chassis features independent suspensions and a backbone tube frame. It allows each wheel to move independently, with improved steering, and maximum loading bed-to-ground contact, while the chassis is extremely resistant to torsion and bending. This is provided by a solid 3D frame that also protects all drivetrain components against impacts, dust, and humidity. Vehicle height and clearance are adjustable.

The tiltable armoured double cabin with four doors is placed over the engine (COE) and provides enough space for a crew of five on energy absorbing blast seats. The level of ballistic and anti-mine protection according to STANAG 4569 can be adjusted, depending on military requirements,



Scania P440 with an armoured cabin.

440 series trucks come with a low forward control cab and a 440 hp (324 kW) engine. C indicates dimensioning for heavy-duty construction vehicles. The trucks offer the levels of flexibility, serviceability and performance sought in present day defence operations.

The large range of components within the Scania modular system enables operators and body manufacturers to create vehicle specifications that precisely meet defined requirements. The modularity allows the vehicles to be adapted to any missions and demands within 24 hours, including the attachment of sufficient armour. The trucks are readily serviceable in commercial garages using local civilian mechanics and spares.

In the P 400 range a variety of three- and four-axle configurations has been implemented, including 8x4, 8x6 and 6x4 vehicles. In line with military requirements, the vehicles can be fitted with hook-lifts of the DROPS/PLS type or with material-handling cranes or container-handling units.

controlling and manoeuvring the vehicle in an efficient way with minimum effort. Large and reachable storage compartments are combined with protective and

Military Trucks Taking Advantage of COTS Products

Defence customers have realised that they don't have to settle for good enough-solutions but can benefit from COTS (Commercial Off The Shelf products) capabilities and get virtually all the necessary functions, but with vastly reduced investments. Instead of buying specialized, very costly solutions, they have realised that our robust, high end trucks offer very attractive qualities. Scania's state-of-the-art trucks stand for solid performance also when it comes to traits like robustness, reliability, traction and load carrying capacity. Defence customers turn their attention to aspects such as service networks, spare parts commonality and long-term supply in order to decrease life cycle costs and secure vehicle availability.

Source: Heikki Fant, Product Manager Defence at Scania Trucks

preventive safety all around. The standard cab is adapted for military usage with a number of unique and renowned solutions. In a military context the installation of GFE equipment and armoured protection is crucial. The cab is protected against

to Level 2 – 3a/3b or with add-on armour to Level 3 – 3a/3b. The armoured cabin has been designed from scratch with an integrated blast management system and multi-layered scalable armour. By placing the users in the centre of the development

Photo: Heiming



Tatra T815-7T with a two-seater cabin.

process and creating the protection system around them, the cabin offers very high levels of protection at low weight without compromising on comfort or usability. Door opening is power-assisted. The armour has been developed in cooperation with Plasan. Air-conditioning and, if required, CBRN ventilation systems contribute to preserving the crew's sustainability. The air-cooled Tatra T3C-298.90 diesel engine delivers a maximum of 300 kW with

maximal 2,100 Nm torque and complies with the Euro 3 exhaust standard. Higher exhaust standards (Euro 4 or 5) may optionally be implemented using Tatra air-cooled or Cummins water-cooled engines. Thrust is controlled by a manual synchromeshed 14-speed Tatra 14TS210N gearbox with semi-automatic split (automatic Allison gearbox as an option). The gearbox provides power take-off for e.g. an hydraulic winch. Off-road mobility is sup-

ported by longitudinal and transverse differentials as well as by all-terrain-tyres and the Central Tyre Inflation System (CTIS) on the move.

The presently most produced version of the four-axle T 815-790R99 8x8 High Mobility Heavy Duty Tactical Truck features an integrated Load Handling System with container lifting frame (MULTILIFT) interfaced with NATO STANAG 2413 flat racks, bodies and containers.

Conclusion

The protection of crews and logistics vehicles against ballistic and blast threats is permanently included in military requirements. To satisfy the demand, the industry uses trucks constructed mainly from series components and appropriately equipped with state-of-the-art protection technologies. So the optimum solution for the interplay between armour, payload and mobility can successfully be tailored to the demands of the users.

Yet for reasons of costs, the majority of logistics trucks will also in the future be operated only with non-protected cabins. For the time being, swap cabins that could also provide these vehicles with the possibly required protection level are still lacking broad acceptance. ■

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Published in cooperation with the Association of the German Army

Defence Technology Review 2/2016

120 pages, English, **€14.80** (incl. VAT, plus shipping)



MITTLER REPORT VERLAG GMBH Baunscheidtstraße 11 · 53113 Bonn, Germany
Fax: +49 228 35 00 871 · info@mittler-report.de · www.mittler-report-shop.de

“I would deploy F-35 anywhere...”

As commander of its fighting spearhead “Air Combat Command” (ACC), General Herbert J. “Hawk” Carlisle leads all fighter, bomber and ISAR units of the US Air Force (USAF). The future mainstay will be the F-35 Joint Strike Fighter (JSF), which – two years delayed – gave a “sound” European debut in July. Among others, the General outlined to ESD contributor Georg Mader the introduction of F-35 as well as current and future challenges around a “new” USAF doctrine of air superiority at the Royal International Air Tattoo in Fairford, UK.

Photos: Mader



Interview with General Herbert J. Carlisle, Commander US Air Combat Command (ACC)

to Air Force Secretary Deborah Lee James and Chief of General Staff Goldfein. They will say when the aircraft is ready. I'm very confident that this will happen soon – and it will happen first at Hill AFB [Utah]. Meanwhile further capability tests are being run in Edwards AFB [California], crew-conversion happens and weapons and tactics training at Nellis at Eglin [Florida] AFB [Nevada]. And one fact is clear – once IOC happens, I would deploy the F-35 to anywhere.

Gen. Carlisle: The same case as with our Marine brothers. Between 12 and 24 F-35s and their crews have to prove the ability to successfully fire missiles against and drop PGM bombs onto targets and destroy them. All sensors have to be fully functional and their software packages in the latest version have to be stable. Also the challenging logistics ‘cloud’ that manages the maintenance must be connected and functioning to sustain daily operations.

ESD: Please explain the background of the ACC and its creation after the second Gulf War.

Gen. Carlisle: The ACC was created because in the early 1990s tactical and strategic tasks increasingly overlapped. Today, with more than 90,000 active and civilian personnel, it is the largest of the 10 Commands in the USAF. We approximately operate 1,300 airplanes in 34 squadrons on 19 bases and about 70 locations around the world.

ESD: Thanks! On to the F-35 JSF, which has now made its international debut here in the UK. There is now no alternative: it will be the mainstay of your command. When will the USAF now call IOC [initial operating capability] on the LIGHTNING II? Last words were telling August.

Gen. Carlisle: Yes, the F-35 is already here – and has no alternative. About 170 are already built and a number are in operational evaluation, testing and crew-conversion, while in parallel development is still ongoing. The Air Force will declare IOC on combat-ready F-35As between August and December 2016, leaning rather towards August than to the year's end. In coordination with the capability – not time – based commitments of the manufacturer, Lockheed Martin, towards fulfillment of all the benchmarks for the IOC, we will report

ESD: Will IOC happen without the final integrated or automatic F-35 logistics system, ALIS?

Gen. Carlisle: What software today is “final”? But – ALIS is here. The manufacturer has said it will have its version 2.0.2 software ready by the Fall. It is true that this will require more substantial broadband capacity, but that will not be a real problem. We have used ALIS everywhere we are or have been with the plane. Will this also be the case in challenging operational environments? We will come up with something! Is it perfect? No. But 2.0.1 does basically what it should do, even if we'll see more revisions because of issues like duplicated entries etc.

ESD: So there are no “yellow lines” or “red lines” around the F-35 anymore? Because there were such, over several years. And a dozen critical GAO-reports, the “outrage” of senators like John McCain.

Gen. Carlisle: No, there are no yellow or red lines anymore. Nothing in the programme today justifies these attributes. Also not ALIS. Not everything around the JSF is as “green” as we would like to see in order to call it perfect, but “green” will come.

ESD: The USMC has stated that its F-35Bs have been ready for war since last summer, so how exactly will the USAF demonstrate or validate IOC?

ESD: And that is all going to work – by the Fall?

Gen. Carlisle: I'll give you a real-world example, what the young men and women from Hill AFB have reported to me. In the first half of June, 160 of them with seven of 14 F-35A deployed to Mountain Home AFB [Idaho]. The aircraft flew all 88 so-called “Capstone” sorties as planned, 16 GBU-39 LGB were on target, just one went wrong and that was a bomb problem. Overall, 39 out of 40 various weapons reached their goals, a 97.5% hit rate. The aircraft itself had a readiness 92.3%. That gives me the confidence in approaching IOC this fall. The JSF really does spectacular things.

ESD: Yes, like it comes with an integrated self-protection and electronic warfare system, which is discussed less often.

Gen. Carlisle: Yes, the sensors and their software are an order of magnitude better than anything we have had in EW and situational awareness so far. Both in overcoming opposing defences as well as the protection of other own operating resources. But it's true, I also do not discuss this subject in detail – not here.

ESD: There is a new USAF air war doctrine out. What does it say about required future skills, or F-35 and the related fleet mix?

F-35 JSF LIGHTNING II

After two major restructurings, weight reductions and ongoing software revisions, one can observe increasing continuity in the F-35 “Joint Strike Fighter” (JSF), the contract for which was awarded to Lockheed Martin back in 2001. With a “weight” of approximately US\$400Bn, the most expensive single weapons programme in the world this year reports a 57% fall in unit price since 2006 and predicts a drop for the simplest of the three models from currently US\$95M to US\$85M by 2019 – the F-135 engine NOT included. Still there runs the novelty of overlapping development work while already about 170 aircraft have been built. But the component within this often-criticized so-called “concurrent engineering” is clearly winding down. The 18 jets still used for testing accumulated 12,500 flight hours in total, a figure meanwhile clearly overtaken by the F-35 at regular squadrons with 37,950 hours. The three US armed services continue to target 2,443 of the low-observable aircraft with their internal weapons bays, while 10 other nations intend to field several hundred of them and Israel’s IAI also manufacturing wing sets. All these numbers are, however, still far from contracted, in contrast with the 37 for the Netherlands, 27 for Denmark or 56 for Norway. F-35s are stationed at ten military bases in the US and also fly from the final assembly facilities at Fort Worth (LM) and Cameri (Leonardo-Finmeccanica in Italy). The main foreign programme partner is the UK, where six of the jets – including one British STOVL B-model – first arrived in Europe on June 30th. 15% in each F-35 is British, with 63 tail-section and sets of horizontal and vertical tailplanes built in BAE-Samlesbury this year. By 2020, 160 such sets per year will create 2,000 jobs. In 2018, 617 Sqn. – the heritage-carrying “Dambusters” – is earmarked to introduce the first of 138 British F-35Bs, to be shared between the RAF and the RN’s two new aircraft carriers.

(Georg Mader)

Gen. Carlisle: You are talking about the “Air Superiority 2030” document, presented just three months ago. It highlights the problem of threat capabilities that will grow over the next 15 years along two vectors: on the one hand “traditional” enemy

– will be exported and thus made available to other or third countries. On the other hand, it deals with opposing capabilities in spectra that are less predictable, like in space, cyber-warfare, hypersonic weapons, stealth cruise-missiles, new ballistic missiles

ESD: Is it in that context that you recently mentioned new Chinese and Russian developments?

Gen. Carlisle: What I have said was that potential or future opponents have seen how successful and efficient we are. They have observed what happened over the last 25 years and they know that we will win any conflict if we dominate the airspace. They know that and they try to counter it – Russia, for example, with the T-50. But China especially is trying hard to close the capability gap between its aircraft and the USAF and US Navy: indeed the Chinese FC-31 has a striking outward resemblance to the F-35. They know or anticipate what you can do with it and so they are trying with anything in their power – reasonable from their point of view – to copy and obtain such capabilities. Therefore we simply cannot afford to remain even at the current state of technology. That’s why there is a fifth generation fielded and why considerations on the sixth generation now come into play.

ESD: This fielded fifth generation of course includes the F-22A, here flying shoulder-to-shoulder with the F-35. What is your approach to the congressional push to resume production of the RAPTOR?

Gen. Carlisle: Here you have your late answer regarding the future fleet mix. By 2019 F-35 deliveries will achieve 17 per month, but it could any time be even more, the final number of 1,763 [for the USAF] is upright. Not to misunderstand, I admire and appreciate the RAPTOR today as unbeatable and as an awesome spearhead. But I think it is better to spend taxpayer dollars for a higher F-35 production rate to achieve an ever lower unit cost. A comparable “RAPTOR 2.0” would mean all the computers, the on-board equipment and the sensors would need to be made new; they were out of production some time before the last one was handed over in 2012. And when would such a first one be delivered? 2020+? In addition, we are meanwhile already spending money to research the sixth-generation fighter aircraft, its sensors, if optionally manned or unmanned and so on. So, there is a drawn line.... But all that is my personal opinion, these are ultimately decisions of the Congress and the responsible Senators.

ESD: According to this mentioned study, isn’t there a need for a new BVR missile to replace the AIM-120 AMRAAM family? New Chinese or Russian missiles are out, and in Europe the METEOR begins to come operational. While AMRAAM’s basics have been on the pylons since 1992.

Gen. Carlisle: Definitely. To arm the next generation, we need armament of the next



The F-35B LIGHTNING II made its international debut at the Royal International Air Tattoo (RIAT) in July 2016.

systems will evolve, like new combat aircraft and their sensors and weapons: while nations developing them already have these skills or means, those assets – like sophisticated air and air-defence systems

and so on. In 2030 our own air superiority forces will have to face these threats, over a wide range of locations and scenarios. The document – you can download it from af.mil – considers how to respond.

generation as well. While the last version of the AMRAAM [AIM-120D] has “bought” us some time, yes there is a foreseeable end of the system.

ESD: The influential Senator Diane Feinstein from California has recently demanded the postponement the phasing-out of the high-altitude reconnaissance platform U-2. What do you think?

Gen. Carlisle: Yes, the U-2 is unbeatable – and it is based in California! It is true that this manned platform can do things a GLOBAL HAWK [unmanned] cannot do, because of the heights the U-2 can reach. But to maintain these decades-old aircraft has become really, really expensive. Nevertheless the approaching date of retirement also is an issue to further discuss with Congress.

ESD: This brings us to another “construction-site” under your command; the continued refusal of some Congress members to withdraw the A-10A. Where do you stand in this sometimes heated debate?

Gen. Carlisle: This is all about CAS [close-air-support] for ground troops. Yes, there are politicians that with their supporters have good reasons to do support the A-10 in front of the legislature, because the “WARTHOG” is a great asset, with its big gun. Which is partly true, in fact. But a look at the next generation of CAS is needed: you cannot keep the A-10 alive indefinitely. The F-35 has already proven that it can do this job, and it will do so more often in more robust future scenarios. There the WARTHOGs would likely not survive in their traditional role, or would be decimated. The same also applies by the way to F-15s and F-16s. We still have hundreds of them, but in 2030 they will dominate nothing anymore.

ESD: When we are now ending by leaving the platform-level, what is your quote of current and future levels regarding networking or collaborative linking?

Gen. Carlisle: Huge subject. It is a constant challenge around the advantages of the high-end platforms we are fielding, to note that we are behind in bringing up our network-integration at the same pace. Each of the new assets like the F-22 – but this also hits TYPHOON or WEDGE-TAIL [AEW&C] as well – have performed well. They have once again proven that if you get new assets into the hands of those young men and women, amazing and previously unguessed things can happen. But their performance and that of the entire force is highlighting the need for more effective combat multi-domain

integration. That is a constant key work in progress, as these new platforms are driving us further down the road to achieve it – the more so when we get to the link architecture and the “translators” that al-

low us to truly achieve fifth-to-fourth and fourth-to-fifth integration. We struggle but work to bring these disparate parts together in a collaborative, honeycombed environment. ■

US Air Force Declares the F-35A “Combat Ready”

In a flurry of statements, opinions and congratulations, Gen. Herbert J. “Hawk” Carlisle, announced during a press conference at the Pentagon, that the US Air Force had declared Initial Operational Capability (IOC) for the F-35A.

Carlisle lauded the aircraft’s performance, noting that it had met all key criteria for reaching IOC: airmen trained, manned, equipped and ready to conduct basic close air support, interdiction, and limited suppression/destruction of enemy air defences in a contested environment with an operational squadron of 12-24 aircraft; the ability to deploy and conduct operational missions using a programme of record weapons and missions systems; and having all necessary logistics and operational elements in place.



Photo: U.S. Air Force photo/Staff Sgt. Madelyn Brown

F-35A LIGHTNING II aircraft receive fuel from a KC-10 Extender from Travis Air Force Base, Calif., on 13 July 2016 during a flight from England to the US. The fighters were returning to Luke AFB, Ariz., after participating in the world’s largest air show, the Royal International Air Tattoo.

“I am proud to announce this powerful new weapons system has achieved initial combat capability,” Carlisle said. “The F-35A will be the most dominant aircraft in our inventory, because it can go where our legacy aircraft cannot and provide the capabilities our commanders need on the modern battlefield.”

The F-35A is the latest addition to ACC’s fleet of deployable and fifth generation aircraft. It provides air superiority, interdiction, suppression of enemy air defences and close air support as well as command and control functions through fused sensors, and will provide pilots with unprecedented situational awareness of the battlespace that will be more extensive than any single-seat platform in existence.

“This important milestone for our fighter force ensures the United States, along with our allies and international partners, remains prepared to deter, deny, and defeat the full spectrum of growing threats around the globe,” added Deborah Lee James, Secretary of the Air Force.

Gen. David Goldfein, Chief of Staff of the Air Force, said that the dynamic new capability will benefit the joint warfighter.

“The F-35A brings an unprecedented combination of lethality, survivability, and adaptability to joint and combined operations, and is ready to deploy and strike well-defended targets anywhere on Earth,” Goldfein said.

Messages offering congratulations were also received from Lt. Gen. Chris Bogdan, F-35 Program Executive Officer; Jeff Babione, Lockheed Martin’s F-35 Executive Vice President and General Manager; and Mark Buongiorno – Pratt & Whitney’s Vice President, F135 Propulsion System and Military Engines.

Combat against SAM Systems

Ulrich Rapreger

Apart from the suppression of enemy air defence modern air warfare requires the elimination of – preferably – all components of hostile SAM system units.

In almost all operations of air forces, hostile radar-based SAM defence constitutes a threat influencing the planning and execution of air missions.

attacks against SAM units and their development can be traced back to the Vietnam War, when the US Air Force first equipped dedicated combat aircraft for such missions under the designation “Wild Weasel”. The evaluation of more recent conflicts shows that almost all aircraft losses were caused by surface-based Integrated Air Defence Systems (IADS) thus underlining the rising importance of SEAD/DEAD. Besides, new technologies have been implemented in support of significantly improved performance of Russian air defence systems. This

Global

With the lessons learned from “Desert Storm” the development and introduction of new Russian missile systems were assigned top priority. The same applies for the upgrade of components of systems in use. Even before, the transition to mobile and deployable systems had been initiated with the introduction of the SA-10B/C GRUMBLE system, thus enhancing survivability. The strategy of continued technical development is focussed on:

- Maximum mobility of all air defence components like acquisition, control and surveillance devices, launchers and passive sensors;
- Protection of important air defence components with SA-15 GAUNTLET and SA-22 GREYHOUND, as well as air defence artillery for the defence against HARM deployments (e.g. AGM-88), and precision and standoff weapons (e.g. PAVEWAY/TAURUS);
- Employment of mobile EW components for defence against high-resolution radar in combat aircraft as well as jamming and deflecting of different sensors of precision attack weapons.

For this analysis of the threat spectrum the potential threat imposed by western SAM systems delivered to third-party states is not considered. Although they also constitute a significant threat for all kinds of aircraft, shoulder-launched MANPADS with infrared seekers are not considered in the context of this article either.

Close Threat

The term “close threat” describes systems with very different performance and distribution levels located in the districts of Kaliningrad and Belarus. Essentially their ranges cover large parts of Poland and the Baltic states.

- For active and passive air defence there is a brigade in the Kaliningrad district. In support of active air defence there is a regiment with different units, the duties of which encompass electronic surveillance and reconnaissance, as well as electronic countermeasures. Two more regiments form the backbone of active air defence and operate the SA-12 GLADIATOR/GIANT air defence artillery system. One echelon has been equipped with the SA-21 GROWLER system for four years.



Photo: MOD Russia

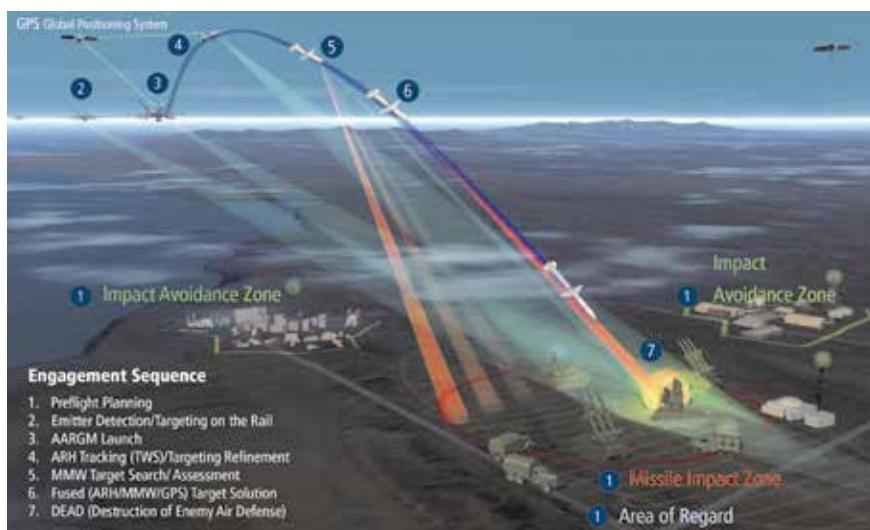
Should the S-500 (successor of the SA-21 Growler, depicted) be deployed in the District of Kaliningrad, Western airspace is inside the range (600 km) of this most modern Russian SAM system.

In case that air space regulations and fuel reserves allow for it, circumnavigating hostile SAM units represents the easiest countermeasure. Where this is not possible, Suppression of Enemy Air Defences (SEAD) or – even better – Destruction of Enemy Air Defences (DEAD) has to be accomplished along the flight routes and in the theatres of operation. According to an early definition from the US DoD, SEAD is described as: that activity that neutralizes, destroys, or temporarily degrades surface-based enemy air defences by destructive and/or disruptive means. This suggests that all military platforms, weapons and procedures including reconnaissance, surveillance, stand-off jammers, air-to-surface weapons and electronic warfare (EW) means contribute to SEAD. Tactics in support of

perception seems to be shared by the German Air Force, which – after a period of some reluctance – now wants to preserve a SEAD capability through modernisation of their type AGM-88B High-Speed Anti-Radiation Missile (HARM) inventory.

Air-to-Ground Threat Spectrum

As a result from the high level of mobility and proliferation of Russian systems threat can be posed in all conflict areas. Some 17 systems with very different performance parameters, the modernisation status of which is partly unknown, are in service with Russian air defence units. Globally, 13 of these systems were delivered to more than 20 countries.



Graphic: Orbital ATK/mawibo-media

Modern air warfare requires the destruction of hostile SAM units.

- Belarus has its air defence assets located in the command areas West and Northwest along the common borders with Poland, Lithuania and Latvia. Two brigades thereof are each equipped with SA-12, SA-11 and SA-5 GAMMON, and one brigade has SA-6 GAINFUL, all of which are supported by different signal regiments.

As a result of this deployment, the NATO QRA assets based in Poland, Lithuania and Estonia are within their reconnaissance and effect reach.

Defensive Tactics against HARM

In all conflicts where hostile IADS have been attacked with High-Speed Anti-Radiation Missile systems the air defence employed most different defence tactics, which were – in part – very successful. These tactics ranged from conventional measures, like switching off radar, through to technologically advanced protection and countermeasures. Some examples are listed hereunder:

Conventional Measures

- Radar employment in hilly terrain or on top of a self-constructed hill;
- Separated locations of search, tracking and fire-control radars;
- Separate employment of transmitter and receiver;
- Direct engagement of HARM with a missile or air defence artillery.

Electronic Countermeasures

- GPS jamming or deflecting;
- Switching off the radar following the launch of HARM;
- Jamming the HARM homing head;
- Launching chaff;
- Employing reflectors with active IR-radiation;

- Active and passive decoys;
- Reduction and alteration of radiation periods, cycles and performance;
- Frequency hopping;
- Active jamming of the HARM carrier platform.

Though not a complete list, these potential defensive measures against HARM illustrate the requirement for increased technological complexity and robustness of modern defensive means and platforms for deployments against SAM units.

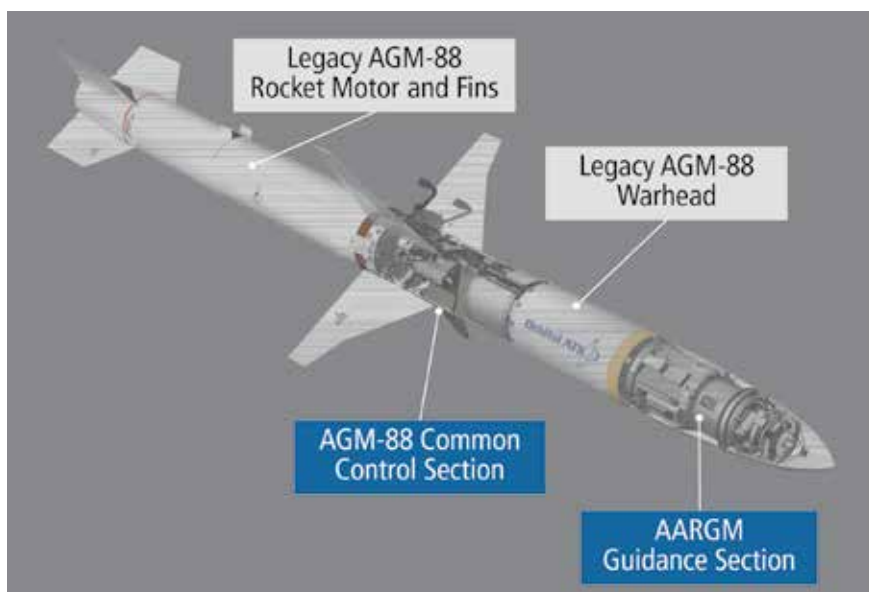
SEAD in the German Air Force (Luftwaffe)

With the procurement of the ECR Tornado (Electronic Combat Reconnaissance) aircraft, which was assigned a dedicated combat capability against air defence units by special equipment in combination with the

type AGM-88B High-Speed Anti-Radiation Missile (HARM), the Luftwaffe confirmed this operational segment as a priority. Until 1992 the Fighter Bomber Wing 32 at Lechfeld was equipped with 35 ECR Tornados and some 1,000 AGM-88B. Apart from numerous modifications the ECR Tornado differs from the IDS version in having upgraded engines (Mk 105), CEDAM (Combined Electronic Display And Map), the ERWE II radar warning receiver, and the Emitter Locator System (ELS), because of which the gun had to be taken out of the aircraft's nose due to space limitations. The ELS acquires signals even beyond the range of hostile IADS frequencies, identifies the radar with a respective database, locates its position and assigns respective priorities for the cockpit display. The AGM-88B air-to-ground missile consists of modules for rocket motor, a common control section, warhead and a guidance section with an Anti-Radiation Homing (ARH) sensor. Prior to launch the ARH sensor measures for the radar frequency and directs the missile after launch into the direction of the radar unit supported by frequency bearing and INS.

With this capability for the suppression of the effect of SAM units, the German Air Force made a significant contribution to NATO's need for critical SEAD assets.

The ECR Tornados were deployed during the Balkan wars of the 1990s, in the scope of the support measures rendered by NATO's IFOR and SFOR protection forces, and as part of operation "Allied Force" from 1998. In more than 400 sorties over 200 HARM missiles were launched. That the ECR Tornados provided effective protection from hostile air defence systems is proven by the fact that not a single al-



Graphic: Orbital ATK/mawibo-media

For upgrading the AGM-88B in German stocks to AGM-88E AARGM the existing legacy rocket motor, fins and warheads can be reused.

lied aircraft was downed. However, these missions also revealed that conventional defensive measures of the opponent – like switching off the radar – were sufficient to substantially decrease the engagement precision of the HARM missile. As this HARM type did not have a system for battle damage assessment, post-strike reconnaissance missions were necessary.

In the course of the Luftwaffe's restructuring, the Tornado inventory was reduced to 83 (of which 20 were the ECR version), and the intended service life was extended to beyond 2035. With different software and hardware improvements like ASSTA 3, the Tornado was upgraded for modern air warfare. A digitised ELS, an improved radar warning receiver and a Link-16 capability all contribute to a better SEAD capability. The inventory of more than 700 HARM AGM-88B, however, constitutes a problem, since they are no longer suited for employment against modern IADS and no longer comply with the present rules of engagement (RoE).

AARGM AGM-88E

AARGM (Advanced Anti-Radiation Guided Missile) is an air-to-ground guided missile developed and optimised by Orbital ATK and MBDA Italy on the basis of AGM-88 for deployment against all components of a SAM unit, including radar systems, launchers and command / support vehicles. AGM-88E has been integrated with the F/A-18C/D HORNET, F/A-18E/F SUPER HORNET and E/A-18G GROWLER of the US Navy and the US Marine Corps. Integration work for 16 Italian ECR TORNADOs will probably be completed in 2016 resulting in an initial operational capability (IOC). It is not yet known when the modification of 214 Italian AGM-88B will be completed. At present, the Block 1 version of AGM-88E is undergoing tests at Orbital ATK and could provide proof of its capability to successfully engage a moving sea target in August 2015. Block 1 already takes advantage of a software upgrade.

The guided missile, which comprises four modules, also offers the possibility to modify older AGM-88B inventories. As a result there is no need to procure a complete new missile in order to improve the SEAD capability.

Warhead

The warhead remains the type WAU-7/B, with features including:

- Manufactured by ATK;
- Weight ca. 68 kg;
- Proximity and impact fuse;
- Approximately 25,000 steel splinters.

The life cycle is believed to last until 2025 and beyond.

Rocket Motor and Fins

Like the warhead, the propulsion unit with the fins is the second module to be adopted from older HARM versions. Features include:

- Manufactured by ATK;
- Solid propellant rocket motor with low smoke emission;
- Launch weight approx. 181 kg

The life cycle of the rocket motor is believed to last until 2025 and beyond.

Common Control Section (CCS)

The CCS is a new development and, in combination with the guidance section, is part of a sensor system. GPS and INS are supported by the Digital Terrain Evaluation Database (DTED) and have Selective Availability Anti-Spoofing Modules (SAASM) for the decoding of precise coordinates, thus generating capabilities as follows:

- High hit precision to avoid collateral damage and threats to own/friendly forces;
- Ensuring compliance with the ROEs by planning and determining the Area of Regard (AOR) with Impact Avoidance Zone (IAZ) and/or Missile Impact Zone (MIZ);
- High-speed attacks from large distances including non-emitting air defence unit elements or high-value targets the coordinates of which were reconnoitred.

Guidance Section

The Guidance Section comprises the advanced digital homing head with Anti-Radiation Homing (ARH) and the active MMW terminal guidance radar. The digital homing head enables the missile to:

- Achieve maximum flexibility and effect at the target by digital signal processing during target acquisition and tracking;
- Discover and identify the majority of current threats with a broader frequency band;
- Achieve a longer range and thus an earlier strike capability, taking advantage of its more sensitive homing head;

- Cover a broader search area with an enlarged angle of view.

The active MMW radar supports the provision of entirely new capabilities. These include:

- The capability for identification of and discrimination between components of IADS and other installations;
- High precision and powerful effect at the target through active terminal guidance;
- High assertiveness and sustainability against defensive measures like switching off radar, GPS jamming or relocation of the unit within the covered area.



Enabling the selection of Missile Impact Zones or Areas of Regard, as well as Impact Avoidance Zones, allows compliance with restrictive rules of engagement.

Outlook

With the technical advancements of the Common Control and Guidance Section, as well as the interaction with the integrated sensors and software, the AARGM AGM-88E responds to current and anticipated requirements (introduction of S-500 Prometey) for an air-to-ground missile for deployment against ground-based air defence systems. In the long term, modification of the propulsion system will be required in light of extended acquisition and engagement ranges of air defence systems. Expected development work for an AARGM Enhanced Range version is funded in the US Navy FY16 Defense Budget. Apart from cost considerations, the work share of the German cooperation partner Diehl Defence will likely be a factor for the procurement decision in Germany. Besides, a solution needs to be found for the Battle Damage Assessment in order to comply with restrictive ROE requirements. ■

Graphic: mawibo-media

Nordic Alternative – the SUPER GRIPEN

Georg Mader

On 18 May 2016 in Linköping, in a highly-impressive light- and projection-show, Saab rolled out the latest member of the JAS 39 GRIPEN series, ushering in a new era, not only for the traditional Swedish brand but for the European defence industry as a whole.

Witnesses were hundreds of guests from the Swedish government and international ministerial level, a number of foreign Air Chiefs and hundreds of media representatives, from Colombia to Indonesia.

The prototype of the GRIPEN E, company designation 39-8, now passes to the Flight Test Department at Linköping, its maiden

Embraer for their own testing programme in preparation for the next 36 to follow. Brasília has also ordered eight twin-seaters, and this version is largely assigned for development and production by Embraer.

Visually there is not much different from the previous GRIPEN airframe: the landing gear has wandered further out into the wings, which creates space for more weapon sta-

and capabilities – all future capabilities, integration of weapons, fuselage tanks and electronic warfare – will be added like apps. The same would even apply, as Saab test pilot Marcus Wundt explained to ESD, to intelligence input regarding potential opponents, such as the T-50 or J-20: an interesting factor for the export markets, although these would not come as easily as uploading an app.

Saab argues that its main rival aircraft from the USA – the stealthy F-35 / JSF – is heading in a difficult direction. All the branches of the armed forces – much-delayed in the meantime – will be equipped with the three JSF variants, in a programme with parallel test and production phases. In addition,

Photo: Saab



flight due to take place later this year. In addition, there are two further testbeds that are already at different stages of production. All will be single-seaters because, with 60 twin-seat aircraft already in-service, the Flygvapnet (Swedish Air Force) has decided it does not need any further two-seaters. On the one hand it still flies 25 two-seat D models; on the other hand, Chief of Air Staff Matts Hellgesson points out their high-quality simulators.

This stands in contrast to export customer Brazil's intentions, as explained to ESD by procurement chief Maj. Gen. José Crepaldi: just one single-seater for Brazil will be built in Sweden, which will then be transferred for initial testing to Brazil, to Saab's partner

tions under the fuselage – in total there are now 10. But much is new on the inside, like the more powerful and supercruise-capable GE-414 engine, the electronically scanning AESA radar, a passive infrared seeker and a 50 cm wide mono display cockpit.

Saab – in an ESD conversation with CEO Håkan Buskhe and Development Director Lars Sjöberg – calls its latest version "Smart Fighter", justified by its digital evolution. The complexity of modular systems today multiplies tenfold about every seven years, so, as with a smartphone, the GRIPEN E incorporated largely proven hardware only to a fixed limit of about 10%, following a concept called Model Based Engineering. Ninety percent of the aircraft's systems

JSF is more of a striker and is so expensive that, for example, the Dutch can only afford 37 and the Danes 27. The "price" of the stealth mantra, the Swedes claim, includes less-than-optimal handling characteristics. Countries that did not accept the price spiral of stealth technology could no longer look to the US for their future acquisitions. And for those who, for political or other reasons, do not want to go for Sukhoi or MiGs from Mr. Putin, the only remaining options are the three so-called 'Eurocanards'. And among these, from the North, not only in combat capability and sensor fusion, but also from the perspective of today's increasingly important lifecycle costs, we now have the latest addition, the new SUPER GRIPEN. ■

Naval Propulsion

Shifting to Hybrid and Integrated Electric Concepts

Luca Peruzzi

Maintaining the all-electric (IEP, Integrated Electric Propulsion) power generation and propulsion is becoming the future, the hybrid (electric) propulsion arrangement maintains the edge throughout a range of surface platforms, from combatant to amphibious and logistic support.

With main combatant ship programmes, such as the Type 45 (AAW) DARING Class anti-air warfare destroyers and the forthcoming QUEEN ELIZABETH Class conventional aircraft carriers for the British Royal Navy and the DDG-1000 ZUMWALT Class destroyers for the U.S. Navy, the two services are leading the adoption of integrated electric power generation and propulsion for surface ships. However, other navies and shipbuilders are looking into a range of propulsion options, incorporating gas turbines, diesel generators and electric motors in different combinations to satisfy the need of current and future surface warships.

After having pioneered the integrated electric propulsion system (IEPS) on the two 18,000-tonne ALBION Class landing platform docks (LPD) commissioned in 2003/04, the Royal Navy and national naval industry developed and put into service the 8,500-tonne Type 45 AAW class destroyers between July 2009 and September 2013. The Type 45's groundbreaking IEPS is based on two Rolls-Royce WR-21 gas turbine alternators that each generate 21 MW, and two Wärtsilä 12V200 diesel generators supplying 2 MW each, which provide electrical power to a high voltage system. The latter is then used to supply power to two GE Power Conversion advanced induction motors (AIMs) with outputs of 20 MW each. The ship's services, including hotel load and weapon system power supplies, are supplied via transformers from the high voltage supply at 440 V and 115 V. The adoption of this innovative and pioneering technology involved some financial and

operational risks, which emerged during the in-service period. Reliability and availability shortfalls affecting the WR-21 GTA are to be addressed, in the long-term, with a diesel generator upgrade to provide the electrical generation capacity required to meet many propulsion and power requirements without reliance on WR-21. In the

The MTGs provide 35.4 MW each and the ATGs 3.9 MW each, combining to deliver an impressive 78.6 MW of total ship power. The GE Power Conversion AIMs were adopted to generate the maximum speed of 30 knots. According to Rolls-Royce, the four turbine generator sets provide increased operational efficiency and flexibility to suit the mission's power requirements, as well as allowing reconfiguration of power output under a range of operating conditions for greater survivability and reduced detectability.

With a design displacement of around 65,000 tonnes and a maximum speed of over 25 knots, the UK's two QUEEN ELIZABETH Class aircraft carriers feature an inte-

Image: US Navy



The 15,600-tonne DDG-1000 ZUMWALT Class destroyers (built by General Dynamics Bath Iron Works) are the US Navy's first type of surface combatant to be equipped with an Integrated Electric Propulsion System (IEPS) composed of two main and two auxiliary turbine generators providing an impressive 78.6 MW of total power.

meantime, the Type 45s continue to operate worldwide.

To meet the speed and current weapon system requirements, as well as provide the potential to incorporate directed energy/laser weapons and an electro-magnetic railgun, the 15,600-tonne General Dynamics Bath Iron Works' DDG-1000 ZUMWALT Class destroyers are equipped with a propulsion system based on two Rolls-Royce MT-30 main turbine generators (MTGs) and two MT55 auxiliary turbine generator sets (ATGs), packaged as the RR4500.

grated electric propulsion system providing a total generating capacity of 110 MW. Provided by an industrial team including Rolls-Royce, GE Power Conversion, Thales and L-3, the IEPS is centred around two 36 MW Rolls-Royce MT30s and the same number of GE alternators, which each make up a gas turbine alternator (GTA). In combination with four Wärtsilä diesel generators (two 9MW and two 11MW) the latter supply high-voltage power to four 20 MW GE Power Conversion induction motors, installed in tandem on both shafts, as well

Author

Luca Peruzzi is a defence correspondent based in Genoa, Italy, and a regular contributor to ESD.



With a displacement of around 65,000 tonnes and a maximum speed of over 25 knots, the UK's two QUEEN ELIZABETH Class aircraft carriers feature an IEPS developed by an industrial team including Rolls-Royce, GE Power Conversion, Thales and L-3, providing a total generating power capacity of 110 MW.



Derived from the TRENT 900 aero engine, the Rolls-Royce MT30 can deliver flat-rated power of 40 MW, making it (according to its manufacturer) the world's most power-dense marine gas turbine. The MT30 has so far been acquired by four customers (the Royal Navy, US Navy, Republic of Korea Navy and the Italian Navy).

as the 13 ship service transformers. These transformers distribute low-voltage power to the weapon systems, mission systems equipment and navigation systems, as well as power to the hotel services required to run the ships. The high-power output provided by turbine-driven electrical generators make gas turbines the prime choice for IEP. The naval applications of these gas turbines are generally developments based on aero engines from General Electric and Rolls-Royce. Derived from the CF6, the GE LM2500 is in

service with 34 navies, having surpassed 75 million operating hours in mid-last 2015. The LM2500+G4's version, the fourth generation of the marine turbine delivering an average output of 35.3 MW, has been selected for the joint Franco-Italian FREMM multirole frigate programme to currently built 18 platforms (plus units for Morocco and Egypt) and the new multirole offshore patrol combatants (Pattugliatori Polivalenti



The Franco-Italian FREMM multirole frigate programme pioneered the introduction of a hybrid electric system in a CODLAG propulsion arrangement. The hybrid diesel electric drive system can propel the FREMM at up to 15 knots. Engaging the LM2500+G4 gas turbine boosts the speed to 27.5 knots.

d'Altura) for the Italian Navy. The Rolls-Royce MT30, however, is a derivative of the TRENT 900 aero-engine and is rated up to 40 MW, making it "the world's most power-dense marine gas turbine", according to the manufacturer. As of today, the MT30 has been acquired by four customers including the Royal Navy and BAE Systems'

Type 26 Global Combat Ship, the US Navy and the FREEDOM Class Littoral Combat Ship (LCS) built by the Lockheed Martin team, the Republic of Korea Navy's eight FFX Batch 2 vessels and the follow-on frigate programme, and the Italian Navy's new TRIESTE Class LHD, under development by Fincantieri. The Ukrainian manufacturer Zorya-Mashproekt is also among the players, offering the UGT25000/DN80 gas turbine with around 26 MW.

Large deck vessels, such as conventional and STOVL aircraft carriers and amphibious assault ships are generally powered by a COGAG (COMBINED Gas And Gas)-based or integrated or hybrid power generation and propulsion system, depending on maximum speed requirements and displacement. Amongst others, the COGAG propulsion system based on four GE LM2500+ GTs has been implemented with the Japanese 24,000 tonne IZUMO Class helicopter carrier, the 19,000-tonne HYUGA Class destroyers, and the Fincantieri-built 27,500-tonne carrier CAVOUR for the Italian Navy, with the Italian ship-builder having provided the same design and technical support for India's first indigenous 40,000-tonne carrier VIKRANT. The same propulsion arrangement is also

used for smaller combatants including the Republic of Korea Navy's 10,500-tonne KDX-3/SEJONG DAWANG Class destroyer and the U.S. Navy's ARLEIGH BURKE Class destroyer (Flight I, II, IIA and III), which also uses Rolls-Royce GTAs to provide electrical power to platform and combat systems. A combined diesel and gas turbine or all



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Photo: Bundeswehr

The German Navy's four 7,300-tonne frigates of the F125 BADEN-WÜRTTEMBERG Class have been designed with a CODLAG propulsion configuration that meets the requirement to contribute to expeditionary operations for long periods with reduced maintenance demands.

diesel-electric configuration is also used for other large platforms, including the Navantia-designed and built JUAN CARLOS LHD for the Spanish Navy and two CANBERRA Class LHDs for the Royal Australian Navy. Two 7,4 MW MAN 16V32/40 diesel generators, together with a 19.7 MW-rated GE LM2500 turbine-powered generator, deliver power to ship systems and two 11 MW Siemens-Schottel Propeller (SSP) azimuth thrusters, which give the ship a maximum speed of 21 kn. The same platform design has been selected by the Turkish MoD but with a reportedly different propulsion system, based on five 7,4 MW MAN 16V32/40 diesel generators and two 11 MW Siemens-Schottel SSPs.

for high-speed propulsion the gas turbine is mechanically coupled with a gearbox. Again, the Royal Navy has pioneered this propulsion configuration on board the Type 23 frigates, with the FOC entering service in 1990. These frigates feature two Rolls-Royce Spey SM1A/C 13.9/19.5 MW GTs and two 2.9 MW electric motors, which are powered – together with platform and combat systems – by four 1.5 MW diesel generators. These frigates' life extension programme aimed at extending fleet-service until the mid-2030s includes a power generation and machinery update, in the scope of which Rolls-Royce was awarded a one-to-one replacement contract in August 2015 to supply 48 MTU 12V4000

M53B 1,6 MW-rated diesel generators to be delivered from late 2016 to Babcock Marine for repowering work.

The first main shipbuilding programme taking advantage of the hybrid propulsion application was the Franco-Italian FREMM multirole frigate programme calling for ten ships for the Italian Navy and eight for the French Navy (plus two units for export). Both designs feature a hybrid diesel-electric drive with a 2.2 MW electric motor on each shaft and a Renk cross-connected gearbox for speed requirements of up to 15 knots. The French 6,000-tonne AQUITAINE Class frigates have four 2.1 MW MTU 16V4000 diesel generators and one GE 32 MW LM2500+G4 GT in a CODLOG (COMbined Diesel eLectric Or Gas) configuration with fixed propellers, while the Italian Navy's 6,700-tonne BERGAMINI Class frigates feature four 2.1 MW Isotta Fraschini common rail diesel generators and the same GT in a CODLAG configuration with controllable-pitch propellers (CPPs) for a maximum speed of 27.5 knots. Both designs include an azimuthal thruster to be used for safe home return and operations in confined waters. The German Navy's four 7,300-tonne F125 BADEN-WÜRTTEMBERG Class frigates, built by a consortium of ThyssenKrupp Marine Systems and Lürssen as prime contractors (FOC undergoing sea trials with delivery expected in late 2016), have also been designed with a CODLAG configuration, including one 4.7 MW Siemens electric motor on each shaft and a single 20 MW GE LM2500 gas turbine with a Renk gear-

Hybrid Propulsion

Although CODAD (COMbined Diesel And Diesel) and CODAG (COMbined Diesel And Gas turbine) propulsion systems are still used in new building and have been used in recently completed shipbuilding programmes recently completed, the hybrid electric propulsion solution is gaining ground in ship procurements in Europe and elsewhere. It is mostly applied in CODLAG (COMbined Diesel eLectric And Gas) configurations that use the diesel generators to supply power to ship and weapon systems and the electric motors, which are the prime mover at slow and passage speed, while the gas turbine is mechanically connected to the shafts for high speed. Such a propulsion configuration offers a series of advantages for today's naval requirements. These include high fuel efficiency and reduced emissions, together with a low acoustic signature at patrol speeds (depending on electric motor installation), as well as up to 3 MW electric motors with a small footprint and reduced weight, while

Image: Italian Navy



The propulsion system selected by the Italian Navy for its new class of 133-metre, circa 4,500-tonne offshore multirole combatant patrol ship, procured in seven units to be delivered between 2021 and 2026, is a combination of a CODAG (COMbined Diesel And Gas) configuration with a hybrid electric system.

box arrangement, allowing the latter engine to drive both shafts. Four 3 MW MTU 20V4000 M53B diesel generators power both the electric motors and ship and combat systems. A maximum speed of 20 knots is attained in diesel-electric propulsion, reaching 26+ knots in CODLAG.

The UK and Italian navies have also selected a hybrid electric system in combined diesel-electric and/or gas propulsion configurations for the Type 26 Global Combat Ship (GCS) and the Pattugliatore Polivalente d'Altura (PPA) programmes respectively, for general purpose, dual-use and anti-submarine missions. Reduced to eight frigates by the Strategic Defence and Security Review 2015, which will be amended by a new smaller and more exportable general-purpose platform design to maintain frigate hull numbers at 13 to replace the Type 23 Class one-to-one, the 6,400-tonne Type 26 GCS frigate will have a CODLOG arrangement. The latter features two GE Power Conversion induction electric motors mounted on each shaft line between the main gearbox and propellers for quiet drive and cruising speed up to 18 knots, with electrical power generation for cruise propulsion, ship systems and services provided by four 3 MW MTU 20V400 M53 diesel generators. A Rolls-Royce MT30 36 MW GT is mechanically coupled through a cross-connection gearbox (designed by David Brown Gear Systems) to provide boost power for speeds in excess of 26 knots. In addition to the electric propulsion motors, GE Power Conversion also provides the variable speed drivers. With the Type 26 programme, Rolls-Royce for the first time delivers a naval propulsion system with an MTU diesel element meeting the IMO III emissions directive, thanks to an exhaust-after-treatment system using a selective catalytic reduction unit.

The propulsion system selected by the Italian Navy for its new class of seven 133 m, 4,500-tonne offshore multirole patrol combatants to be delivered between 2021 and 2026 is a combination of a CODAG (Combined Diesel And Gas) configuration with a hybrid electric system. Dubbed CODAGOL (COMbined Diesel And Gas Or (diesel) eLEctric) the propulsion layout is based on a

32 MW GE LM2500+G4 GT, two 10 MW diesel engines and two 1.35MW electric motors. Four diesel generators are to provide power for electric motors, platform services and the combat system. The Avio Aero 32 MW GE LM2500+G4 and the two 10 MW medium-speed diesel engines yet to be selected are linked, through a cross-connected Renk gearbox similar to the FREMM design, to the two propeller shafts with CPPs to provide a maximum speed of 32 knots, while the hybrid electric element provided by GE and based on two electric motors (linked by a small Renk gearbox to shafts) and variable speed drives can power

up to 7-10 kn or provide electricity ashore. The two diesels are to generate power for a speed of up to 25 knots (10-18 knots range on single running). All engines are to be dual-fuel while the diesel generators are equipped with Selective Catalytic Reactor (SCR) filters.

The Spanish Navy's future F110 frigate programme, which was launched in 2015, has been laid out to feature a mono-hull with a CODLAG propulsion configuration, but Navantia also propose a novel COMbined Diesel Electric And Diesel Or Gas (CODLADOG) solution. In the Far East, an advanced propulsion configuration has



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**Is the naval industry keeping pace
with operational requirements?**

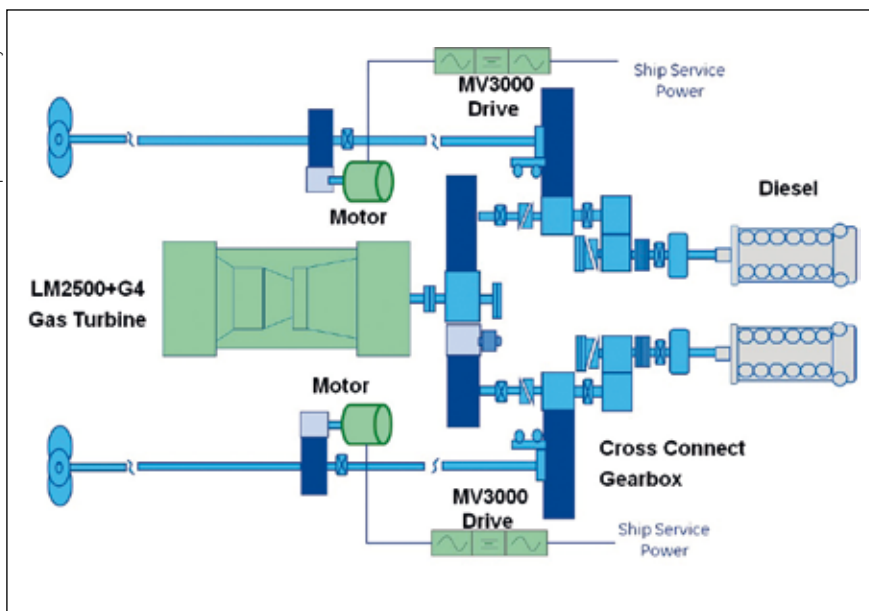
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The propulsion machinery arrangement of the Italian Navy's new PPA offshore combatant patrol ships is based on a 32 MW-rated GE LM2500+G4 gas turbine, two 10 MW medium-speed diesel engines and two 1.35 MW electric motors. GE will be responsible for the hybrid electric system with variable speed drive, while Avio Aero is prime contractor for the GE LM2500+G4 gas turbine and subsystems.

been selected for the Republic of Korea Navy's eight-ship 3,600-tonne FFX Batch 2 and follow-on frigate programme, with the FOC built by Daewoo Shipbuilding & Marine Engineering launched in June 2016. The Hybrid CODLOG propulsion configuration is based on a Hybrid Electric Drive (HED) system provided by DRS Technologies, a Leonardo (formerly Finmeccanica) company, with one-each shaft-mounted 1.7 MW permanent magnet (PM) motor for cruise speed of up to 15 knots, coupled for the first time with a 40 MW Rolls-Royce MT30 GT and offering a top speed of 30 knots. According to DRS, the HED has a significant advantage in size, weight and power over conventional electric motors and produces more torque from the same amount of current supplies.

To reduce fuel consumption and emissions, and to enhance operational flexibility, the hybrid electric drive system in the CODLOG/CODLAG configuration was also selected by the US Navy for its fleet of new large amphibious assault ships and is being applied to the COGAG-based ARLEIGH BURKE Class destroyers. Starting from the WASP Class LHD, the follow-on and larger AMERICA Class LHAs are equipped with CODLOG propulsion systems including two GE Power Conversion 3.7 MW electric motors powered by six Fairbanks Morse 4 MW diesel generators (also for ship systems) for speed

up to 12 knots, and two 26 MW LM2500+GTs providing power for speeds of up to in excess of 20 knots. In the scope of the 'Great Green Fleet' initiative, the US Navy will begin installing an L-3 provided HED system on 34 Flight IIA ARLEIGH BURKE destroyers starting later this year to use electric propulsion for speeds of up to 13 knots.

Hybrid electric propulsion or integrated electric propulsion (IEP) solutions have also been selected for and/or applied to a range of amphibious and logistics vessels. The Italian Navy's new TRIESTE Class LHD, to be delivered by a Fincantieri-led industrial team in 2022, will feature a Combined Diesel Or Gas turbine propulsion configuration with electric motors. The latter two are required as electric generators and to power the LHD at speed up to 10 knots, the two 11,2 MW medium-speed diesel engines at 18 knots and

the two MT30 GTs at 25 knots. Electrical power is provided by four 5,4 MW diesel generators.

In addition to the UK Royal Navy and US Navy programmes already referred to, GE Power conversion also provides the electric power and propulsion system for the four 37,000-tonne new MARS (Military Afloat Reach and Sustainability) TIDE Class tankers of the UK Royal Fleet Auxiliary and the single 26,000-tonne Logistics and Support Vessel (LSV) for the Royal Norwegian Navy, both designed by BMT

Defence Services and built by the South Korean Daewoo Shipbuilding and Marine Engineering shipyards. Both ship designs use similar propulsion configurations with two 7,2 MW Wärtsilä 6L46F diesel engines driving twin shafts in a hybrid CODLOG arrangement with electrical motors and two Wärtsilä 3,4 MW 6L32 generating sets, designed for fuel efficiency across a wide range of speeds. The Italian Navy's new 23,500-tonne Logistic Support Ship (LSS) to be

The MAN Diesel & Turbo family of V28/33D STC diesel engines has been selected by a number of navies for different applications, including the Royal Netherlands Navy's HOLLAND Class OPVs, BAE Systems-built OPVs for different navies and more recently by the Indian Navy for the latest P-17A frigates.

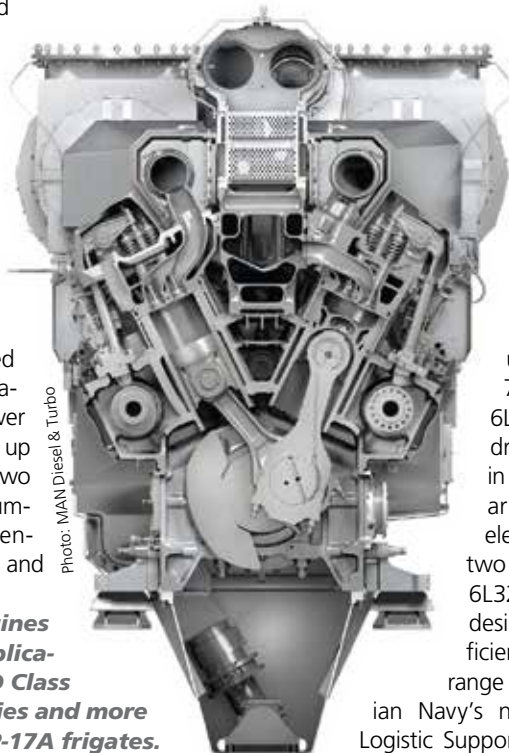


Photo: MAN Diesel & Turbo



GE Power Conversion provides the electric power and propulsion system for the UK's 37,000-tonne RFA TIDE Class tankers and the single Royal Norwegian Navy's 26,000-tonne Logistics and Support Vessel (LSV), depicted here. Both were designed by BMT Defence Services in the UK and are being built at South Korea's Daewoo Shipbuilding and Marine Engineering Shipyards.



delivered by 2019 by Fincantieri will have a CODLAD (COMbined Diesel-eLectric And Diesel) propulsion configuration with two MAN 12 MW 20V32/44CR diesel engines and two 1,5 MW electric motors powered by four MAN 2 MW 6L27/38 diesel generators together with ship and combat systems.

Vessels smaller than destroyers and frigates do not require a gas turbine to achieve high-speeds, but a diesel-electric or hybrid solution for endurance at low speed. A range of propulsion configurations and engines has been used and is being adopted to reduce fuel consumption, optimising mission profiles and reducing emissions. The CODLOG configuration is used on board the Irish Navy's SAMUEL BECKETT Class OPV and the Royal Netherlands Navy's 3,800-tonne HOLLAND Class OPVs. The latter are equipped with two MAN 5.4 MW 12V28/33D diesel engine connected to both shafts with Renk gearboxes for a maximum speed of 22 knots while the 400 PTI electric motor can provide up to 10 knots powered by three 1 MW Caterpillar diesel generators. To obtain a greater-than-average maximum speed, the propulsion configuration comprises waterjet elements, driven mechanically by a diesel or gas turbine. The 3,600-tonne MEKO A-200 (South African and Algerian Navy) corvettes comprise two 5.9 MW MTU diesel engine and a 20 MW GE LM2500 gas turbine. Four waterjets in a CODAG (WJ) configuration are used to Power the USN's Littoral Combat Ships, both the monohull version built by Lockheed Martin and the trimaran by Austal USA. The former uses two Rolls-Royce MT30 36 MW gas turbine, two 6.4 MW Colt-Pielstick diesel engines and four Kamewa waterjets, together with four Isotta Fraschini 0.8 MW diesel generators, while the trimaran version uses two 20 MW GE LM2500 GTs, two 8.2 MW MTU diesel engines, four diesel generators and the same number of Wärtsilä waterjets. Among naval platforms using hybrid CODOE/CODLOD configured propulsion are the Damen proposed SIGMA patrol corvette and frigates such as the latest 10514 model, of which two ships have been procured by the Indonesian Navy with two 10,000 MW MAN 20V28/33D STC diesel engines and two 1,3 MW electric motors, or the Royal Navy of Oman's BAE Systems KHAREEF Class corvettes, which are equipped with two 9,1 MW MTU 20V800 M91 diesel engines and two 280 kW electric motors and a Renk gearbox. The same applies for Oman's ST Marine AL OFOUQ Class OPVs, the propulsion system of which differs mainly for more powerful electric motors. However, there are still navies that prefer CODAD (COMbined Diesel And Diesel) propelled new surface combatants, such as the Royal Danish Navy's IVER HUITFELDT Class frigates with four MTU diesel engines generating 33 MW, the PLAN Type 054A JIANGKAI II frigates with diesel engines from SEMT Pielstick's Shaanxi Works, or the Republic of Singapore Navy's 1,250-tonne Littoral Mission Vessel (LMV), the first-of-class delivered in May 2016, equipped with four MTU 4,3 MW 20V4000 M93L engines coupled to two shaft-driven CPPs, providing a maximum speed of 27 knots. ■

Masthead

European Security & Defence

Issue 4/2016, August 2016
ISSN 1617-7983 · www.euro-sd.com

Published by

**MITTLER
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Supported by the editorial team of "Europäische Sicherheit & Technik"
Publishers: Rainer Metzner, Henning Bartels

Layout:

davis creativ media GmbH, Bonn, Germany

Production:

Lehmann Offsetdruck GmbH
22848 Norderstedt, Germany

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European Security & Defence
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Cover Photo: Daimler, US Navy, Helmoed Roemer Heitman

Annual subscription rate (6 issues):
€49.80 incl. postage

Chemical and Biological Sensors

Technology and Market Trends

Dan Kaszeta

Sensors are a vital part of chemical and biological defence and response capabilities. Often lumped together as “the detection market” or “detectors”, there is a lot of segmentation in this market.

A wide number of technologies are in use. This “detection space” needs to be unpacked into its various components. Radiological and explosive sensors are of-

space improved in recent years? A detailed investigation of the reliability, accuracy, and false alarm rates of detection instruments would exceed the allotted space for this



Photo: US Air Force

Smiths Detection HazmatID 360 in use with the US Air Force.

ten considered alongside C and B, to make a CBRNE acronym, but they are quite different. Brevity requires a later discussion of radiological/nuclear and explosive detection technologies and products.

Some generalisations are applicable to chemical and biological sensors. Have sensor technologies and instruments in this

article. However, a reasonable assessment is that the latest generation of sensors is generally superior in most ways to previous generations. Another generalisation is that chemical sensors are superior to biological sensors in most aspects. There seems little prospect for this to change.

Yet another generalisation is that the USA drives the market and has done so for some time. The US market accounts for approximately 50% of world spending in CBRN in most years. The US military, and its specifications behind its major acquisitions, have been the driver of many technical developments. The fact that major non-US players set up US subsidiaries, while US players do not always bother with non-US sales is no small sign of the weight of the US market.

Chemical Instruments

Chemical warfare agent (CWA) detection instruments are divided into several categories. The first are point sensors. These are handheld, fixed, or man-portable instruments that detect hazards, generally

airborne ones such as gases, vapours, and aerosols. There are myriad instruments that are in use in civilian settings for hazard monitoring, a market space dominated by industrial safety manufacturers like RAE Systems (US), MSA (US), Dräger (GE), and Honeywell (US). This segment is so diverse that it is hard to characterise here. These sensors generally use photoionisation (which generically detects volatile organic vapours and gases) or various single-substance techniques to detect things like combustible gases, carbon monoxide, or oxygen. This market is quite stable, full of very similar products, and driven far more by industrial customers than by public sector ones. The sensitivity and selectivity of these civilian instruments often makes them unsuitable for many military uses.

Military CWA Point Detection

The general requirement is for detection of hazards in a short enough timescale to allow soldiers to put on protective equipment, detect the presence of contamination, and to help decide when it is safe to remove respirators. Most have some capability to detect high-risk toxic industrial chemicals (TIC) as well. This is called “Detect to warn” and has effectively excluded many technologies from this space. The core products are ion mobility spectrometers (IMS). By far, the market leader here is Smiths Detection (UK) with its family of CAM, GID, and LCD products, all of which derived from their successful bids to win major US chemical detection contracts. Large US military purchases allowed economy of scale, so their LCD series (which won the US JCAD contract) competes well on price, size, and performance. This product family has market penetration in dozens of countries. The US JCAD programme has brought about order of magnitude improvements in size, performance, and net price. The older Smiths products, such as the CAM and the GID-3, but are gradually retiring. The other major players are Bruker (GE) and Environics (FI), both with long-standing market bases but lower market share for their baseline CWA detection products. Chemring (UK) and Aisense (GE) have IMS CWA detectors, but with small markets. Improvements in IMS have been slow in recent years and generally were only driven by the large JCAD programme. An alternative technology, flame ionisation spectrometry, has al-

Author

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Photo: Dan Kazeta

RAE Systems AreaRAE toxic industrial gas monitor and M4 JCAD

lowed Proengin (FR) to have a niche market as an alternative technology provider. Flame ionisation has not progressed significantly in many years. FLIR (US), after tentative steps into this space, seems to be focussing more on explosives and narcotics detection. Niche technologies and sensors also exist. Surface acoustic wave interferometry was once touted as a possible CWA technology, but only one product remains on the market, the late 1990s vintage HazmatCad sold by MSA (US). FLIR has an enzyme-based detec-



Photo: US Army

US Army Joint Chemical Agent Detector, made by Smiths Detection

tor, the FIDO C3. BPSI (US) has a niche fixed-site building protection systems focussed more on TIC detection than CWAs. Saab (SW) and Rheinmetall (GE) participate in this market, but more as integrators than sensor manufacturers.

Identifiers

Identifiers are intended to help the user identify unknown substances, such as gases, liquids, or solids. They do not work in

“real time” and so do not provide a “detect to warn” capability. These are usually fielded with specialised teams, mobile laboratories, and in CBRN reconnaissance vehicles. The higher end of this segment uses gas chromatography and mass spectrometry (GC/MS). Such systems have long been a forte of Bruker, which makes them for many markets beyond the CBRN business. Inficon (CH) has had good market share in the GC/MS market for man-portable systems, reinforced by large orders to equip US National



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Photo: Dan Kaszeta

TruDefender handheld FTIR device made by Thermo Fisher Scientific

Guard Civil Support Teams. FLIR's GRIFFIN range of GC/MS, has some market presence, although their marketing strategy is oriented at explosives and narcotics. Smiths recently entered the portable GC-MS market with the "GUARDION." It is too early to gauge the success of this move.

Fourier Transform Infrared (FTIR) spectroscopy occupies the middle of the identifier spectrum, in terms of size and price. FTIR devices derive the "absorption spectra" of a substance, giving the ability to "fingerprint" many categories of chemical compounds. The pioneer in this segment was SensIR, a US firm, bought by Smiths Detection in 2004. The Smiths HazmatID family is still a benchmark product in this field, propped up by large buys in the US military and emergency response market. The GasID attempts to do the same for the more difficult task of gas/vapour identification, although it is a harder instrument to use with lower market penetration. Thermo Fisher Scientific has a viable product offering in the FTIR space, with their "TruDefender" and GEMINI sensors.

A growing number of companies are producing interesting products using Raman spectroscopy. This technique shines a laser into a solid or liquid and analyses the scattered light produced by the laser's interaction with molecules. Like FTIR, this is a "fingerprint" type of analysis. Thermo Fisher, which bought the boutique spectroscopy firm Ahura in 2010, is a market leader with heavy penetration in civilian emergency services. Their recent "GEMINI" combines Raman with FTIR in a single instrument: anecdotal feedback on this approach is mixed. Smiths Detection fields a Raman offering that has far less market penetration. The



Photo: Dan Kaszeta

Serstech 100 Indicator handheld Raman spectroscopy device

Japanese firm Rigaku has strong Raman offerings, although security and defence are a small percentage of their business. A cluster of smaller firms, such as 908 Devices (US), Cobalt (UK), and Serstech (SW) offer interesting Raman devices. All are serious competitors on the basis of price, size, and performance when placed alongside the Thermo Fisher and Smiths devices. Improvements in all three of these identification technologies (GC/MS, FTIR, Raman) have been incremental, rather than revolutionary. Size and weight continue to reduce and software continues to improve.

Standoff Detectors

The ability to accurately detect and characterize chemical threats at a significant distance is considered by some to be the "holy grail" in CBRNe. Standoff detectors usually use passive ambient infrared light and FTIR spectroscopy (similar in principle to the identifiers) to collect information about airborne gases, vapours, and aerosols to distances of up to several kilometres, depending on atmospheric conditions and lines of sight. Historically plagued with accuracy and false alarm problems, as well as issues of affordability, such devices have existed in one form or another since the early 1990s. Northrop Grumman (US) and Chemring (UK) both have passive standoff sensors. Chemring's I-SCAD is also the US JSLSCAD, the existing US military standoff detector. ABB and Telops, both in Canada, have niche offerings in this area. Outside North America this space has clear offerings from Bertin (FR) – the SECOND SIGHT family of sensors – and Bruker, which has long held a position with its RAPID product line. Active laser-based systems are certainly technically possible, but most militaries are extremely reluctant to use them for safety and legal reasons. Slovakian companies MTI and SEC produce offerings in this small segment. Finally "wet chemistry" is still a valid technique in chemical detection. There are various traditional chemistry sets, detector papers, gas detection tubes, and similar

analogue detection techniques that still fill useful niches and often offer lower prices. Tradeways (US), HazTech Systems (US), Dräger, FLIR, Ketech (UK), and Oritest (CZ) all have product lines in this segment.

Biological Sensors

Biological warfare agent (BWA) detection still suffers from technical problems, due to the inherent difficulty of detecting small quantities of biological threat material out of a large natural background. Significant funds have been expended, but practical progress is elusive. The gap between biology and electronic instrumentation is far greater than in other areas of detection. Far less capability is available than in chemical detection and the market reflects this. There are fewer products on the market now than there were even a few years ago. There are fewer manufacturers participating in this market. Some start-ups have come and gone. Major players, like Smiths, have discontinued substantial product lines, such as the SMART BioSensor and the BioSeeq, both of which had been problematic and expensive.

The complex nature of biological surveillance means that multiple technologies and systems need to work together in synergistic or orthogonal ways to provide useful capability. "Detect to warn" is largely considered unfeasible as the technology simply does not work fast enough. "Detect to treat" – the ability to provide post-exposure countermeasures like drugs or vaccines, is the objective. There are some existing large integrated systems – such as the UK IBDS (Smiths Detection), the various US programmes such as JBPDS (Chemring) and BioWatch (numerous contractors), which have numerous components.

The front end of biological detection – sampling and triggering – is crucial, lest the cost of consumables bankrupt even the rich customers. Samplers collect particles from the air. Triggers help to determine whether a biological event has occurred by examining size, shape, and number of

particles. Fluorescence is the main trigger technology. Manufacturers include Biral (UK), Bertin, Dycor (CDN), FLIR, Research International (US), Innovaprep (US), Innovatek (US), Laurus (US), PIMCO (PL) and TSI (USA). Air Techniques (US) is a new entrant in this space: this is a sector with much SME involvement.

In terms of actual identification, DNA Polymerase Chain Reaction (PCR) and immunoassay are the two prevalent technologies. While both PCR and immunoassay allow for specific detection and identification of BWAs, neither is perfect. Dead microbes can cause positive DNA or immunoassay responses. Live microbes can be present in quantities too small for a reasonable positive. Immunoassays have had false positives in the past – but immunoassay works more quickly than PCR. The key players here are Battelle (US), Biofire (US), Thales UK, Chemring, and Smiths. Bruker enters this market with the pBDi, a competitive immunoassay detector that avoids optically reading immune response, a potentially key improvement. A new entrant is qLinea (SW), with potentially improved DNA analysis.

As with chemical detection, there are manual test kits and handheld sensors that are useful and economical capabilities. Smiths Detection has the BioCheck and PrimeAlert, both designed for assessing suspicious powder incidents. Many companies, as well as



Photo: SEC

The Slovakian company SEC developed the FALCON 4G series of standoff detectors for chemical and biological warfare agents.

some government agencies, produce handheld assays for immunoassay detection of specific pathogens or toxins. ANP (US) and Alexeter (US) are examples.

Future Developments

Major developments in this sector require major investment. This investment is far more likely to come from major government programmes rather than internal R&D expenditure. What works in a laboratory cannot always be translated into a



Bruker Daltonics' new pBDi biological sensor

field environment. Both existing and new players are involved in the US military's Next Generation Chemical Detector. This will be "The Next Big Thing" in chemical detection. The area to watch in biological detection is standoff systems. As always, the biggest variable is world events: as in the past, a serious chemical or biological incident may tilt more money into industry, driving quicker development.

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South Africa's Defence Exports

Helmoed Roemer Heitman

The South African defence industry is relatively small, but has a remarkable breadth of capabilities and an even more remarkable depth in certain technologies. Despite the challenges of an under-funded defence force that cannot afford even key acquisitions or much R&D, and despite inadequate government support, it continues to export to most parts of the world, and continues to develop new equipment and systems.

That is a result of three factors: innovative thought and a focus on affordable equipment that works; a well-developed research and development base, coupled to capable test and evaluation facilities; and the presence of major international groups, which brought capital, new manufacturing techniques and market access. The latter resulted from the 1999 acquisitions for the Air Force and Navy, which were linked to defence industrial participation (DIP) requirements. That forced the bidding companies to look closely at the local industry, and several saw enough potential to invest, in all but one case to real mutual benefit. The main South African defence groups are the state-owned Denel, three former divisions of which are now majority foreign owned with the state retaining a "golden share", the defence arm of the listed Reutech group, the Swedish-owned Saab Grintek Defence and the privately held Paramount. All have been successful on the export market, as have some smaller companies.

Guided Weapons

One would hardly expect a small industry to succeed with guided weapons, but Denel Dynamics has proved it possible. Exports include the UMKHONTO SAM to the Finnish and Algerian navies, the 10,000 m range MOKOPA to Algeria for the SUPER LYNX, the INGWE laser beam-rider to Algeria for the SUPER HIND and Malaysia for new infantry combat vehicles, and the UMBANI guided bomb kit, being manufactured in the United Arab Emirates as the AL TARIQ by Tawazun Dynamics, a 51/49% joint venture by Ta-



Denel Dynamics' UMKHONTO surface-to-air missile at launch

wazun and Denel. Nearing production is the A-DARTER 5th-generation short-range AAM developed with the Brazilian Air Force and industry.

Previous exports include RAPTOR guided stand-off bombs to at least two air forces and SEEKER UAVs to Algeria and the UAE, the latter having employed it very successfully in Afghanistan, and there may be an export customer for the new SEEKER 400. In its previous incarnation as Kentron, which included what is now Airbus Optronics, Dynamics developed the optical head-tracker for helmet sight and display systems, now in service on

the GRIPEM and Eurofighter TYPHOON. Other products include auto-trackers and guidance systems for precision weapons of other companies, one a major European group, and Dynamics is currently developing a low cost course-correcting artillery fuze.

Electronics and Optronics

The South African industry has also been surprisingly—for a small industry—successful in defence electronics and optronics. Reutech Communications has exported radios and equipment widely, report-

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The MOKOPA ATGW, shown here on a SUPER LYNX, can be launched from fixed and rotary wing aircraft, ships, land vehicles and static posts.

edly including India and Malaysia for their Su-27 and Su-30 fighters. Reutech and Grintek Communications (now part of Reutech) pioneered frequency-agile radios and Reutech still leads in some aspects. GEW Technologies, majority owned by Airbus, has been active in communications intelligence and jamming for more than forty years, developing and exporting equipment, most recently including IED jammers.

Reutech Radar Systems has exported its X-Band 2D RSR-210N surveillance radar to the Royal Norwegian Navy, for the Nansen class frigates, and the mobile variant of its RSR900 LPI "StealthRad" radars to an undisclosed customer. Under contract to a major European company, RRS has developed and delivered a signal and data processor to provide an air surveillance capability to a network of coastal surveillance radars installed along the coast of a central European nation, stabilised radar platforms for five corvettes of a major NATO navy and radar rotator systems that have since been adopted by other European radar suppliers, with 35 currently in service in several navies. RRS also developed the RSR 150 radar for self-protection systems such as the Saab Grintek Defence LEDS.

Saab Grintek Defence is the main actor in the ESM/ECM field, having built on the innovative work carried out by Grintek Avitronics. It develops and exports equipment for air force, navy and ground forces applications. Among its exports have been integrated aircraft self-protection systems to India (Su-27, light attack

helicopter, light fighter) and Switzerland (helicopters); naval systems to Germany (mine-hunters) and the UAE (BAYNUNAH corvettes), and the LEDS system for armoured vehicles to the Netherlands (for the Army's ICVs). It has also exported attack periscope radar warning receivers to several navies, including that of South Korea.

Airbus Optronics, formerly Denel Optronics, has been very successful with its EO/IR payloads for helicopters and light aircraft (LEO) and UAVs (GOSHAWK), including sales to European countries, Russia and China. The most recent LEO III HD has four-way focal plane array (R, G, B, NIR) multi-spectral zoom and spotter TV sensors, and offers image fusion between daylight and thermal imager sensors, and continuous optical zoom. It can incorporate a laser range-finder and laser designator (or just a laser illuminator or pointer) and an ITAR-free IMU. The GOSHAWK II HD offers similar capability, constrained only by size and mass limits

Research and Testing

The defence acquisition agency Armscor has a Defence Science and Technology Institute comprising several units covering a range of fields: Institute for Maritime Technology, Protechnik (CBR detection and protection), Hazmat (protective masks, filters, activated carbon), Ergotech. Flamengro (fluid and mechanical engineering) and Armour Development. The Defence, Peace, Safety and Security arm of the Council for Scientific and Industrial Research (CSIR) has units specialising in aeronautics (with a comprehensive set of wind tunnels), command & control and information warfare, integrative systems (addressing national-level issues), landward sciences, optronic sensor systems, radar and electronic warfare, and technology for special operations. Those units can also draw on the expertise of other CSIR arms, for instance materials science and manufacturing, modelling and digital science, the centre for high-performance computing and the national laser centre. In addition, research contracts are awarded to the leading universities. The main test and evaluation facilities are Denel's Overberg Test Range (aircraft weapons, guided weapons), Armscor's Gerotek (vehicle test range, antenna test range, electromagnetic compatibility, electronic, electrical and mechanical testing) and Alkantpan (gun systems) and the CSIR's Paardefontein satellite radiometric calibration site, with which is collocated an explosives and penetrators test site.

for UAV applications, and its HDT variant also includes a laser designator. Optronics also manufactures optical submarine periscopes for export, as well as a range of hand-held devices.

Among the smaller companies is Ansys, whose Parsec subsidiary produces the

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A variant of the BADGER's turret has been ordered by Malaysia.



The AGHRAB 120 mm mortar system on an RG31 variant has been exported to the Middle East.

camera subsystem of the Denel-developed optical head tracking system for fighter helmet sight and display systems. Parsec also produces launcher electronic units for the ROOIVALK and SUPER LYNX. Other products are in signal processing, and Ansys previously developed smart launchers for the TIGER attack helicopter. Other small companies include Sysdel (ESM systems) and antenna specialist Alaris, which recently acquired the Finnish antenna company Cojot Oy.

Armoured Vehicles

For some years South Africa was well-known for mine-protected, MRAP and mine-detection vehicle systems. While the large orders have ended, the industry is still exporting these vehicles and developing new ones.

Denel Land Systems is the prime contractor for the SA Army's new BADGER infantry combat vehicle, developed from the Patria AMV. While this is not itself

an export programme, the turret developed by DLS for the Badger has won a €350 million order from Malaysia. The Malaysian version will mount the 30 mm cam-driven cannon developed by DLS, and Denel Dynamics INGWE missiles.

Also part of the package are Reutech Land ROGUE overhead weapon stations. The largest exporter has been BAE Land Systems SA, now Denel Vehicle Systems. In its BAE incarnation it sold large numbers of mine-protected and MRAP vehicles to several countries – more than 2,300 RG31s to twelve countries (more than 1,900 to the US) and more than 600 mine-hardened RG32Ms and RG 32LTVs to eight countries (380 to Sweden). The RG35 4x4 and 6x6 MRAP APC has been sold to Nimr in the UAE for local production, with DVS to undertake further development and initial manufacture. Other types include the RG33 developed for production in the US, the RG12 police vehicle exported in reasonable numbers, the RG34, sold in small numbers to Malaysia, and the 8x8 RG41.

Land Mobility Technologies (LMT), majority owned by DLS, has exported more than 1,000 armoured vehicles, mainly to the Middle East. Products include the 13-ton, 120 km/h LM13 APC and the 16-ton LM14 MRAP types and various specialised vehicles. LMT also develops vehicles for other companies and developed and exported armoured and mine-protected cabs for Mercedes ACTROS (exported to Canada) and ZETROS trucks, a protection kit for the HMMWV, and armoured personnel containers for trucks. LMT also developed the flat-bottom mine-protection system of the BADGER ICV, as well as its new rear door, which has stowage for section weapons and ammunition, and the complete interior.

DCD Protected Mobility sold 1,000 HUSKY mine-detection vehicle systems to the United States, and smaller numbers to seven other countries, most recently to Turkey. The company has also exported its SPRINGBUCK mine-protected patrol vehicle to Nigeria, where it is to be manu-



The 155 mm T5-52 is being offered for export.

factured under licence, and has another order from an East African country. It is still looking for an export customer for its MOUNTAIN LION 4x4 (and four-wheel steering) MRAP APC.

Denel Mechem is best known for demining in former conflict zones, but has also exported its CASSPIR NG2000 mine-protected APC to several countries in West Africa, and has developed it into a complete family of vehicles including a wide-body variant for use as ambulance or command vehicle, a weapons carrier variant and 4x4, 6x6 and 8x8 protected logistic and recovery variants. All can be supplied with various power-trains/drivelines. Mechem has also exported soft-skin trucks using the same powertrain/driveline components.

Paramount has exported its MARAUDER and MATADOR mine-protected APCs, some 200 of the former to eight countries and smaller numbers of the latter. More importantly, it has manufacturing agreements in Azerbaijan, Kazakhstan and Jordan, the latter reportedly also intending to manufacture 50 of the 6x6 MBOMBE APC. Most recently the company revealed an 8x8 APC/ICV that shares mechanicals with the MBOMBE. There is also a 4x4 variant derived from a design developed by IAD before it was taken over by Paramount. The company has also produced protected police vehicles.

Integrated Convoy Protection has sold more than 400 REVA mine-protected APCs to eight countries, the most recent being Nigeria, others including Thailand and Saudi Arabia. The company also offers a mine-protected 6x6 recovery vehicle, which could be developed for other applications. Similarly, OTT Technologies has sold more than 200 M26 and M36 mine-protected APCs to Kenya and countries in West Africa, as well as light attack vehicles based on the SAMIL-20 truck, and also offers a 6x6 recovery type. The company also refurbishes other ex-SA Army vehicles for export.

Artillery

Denel Land Systems is well known for long-range artillery,

particularly the 155 mm G5 and G6, both of which have been exported; the G5 to Malaysia and the UAE, and the G6 to Oman and the UAE. There is also the truck-mounted T5-52 based on an 8x8 Tatra truck. A newer product that should attract foreign interest is the long-range (30 km) 105 mm gun, which offers the range of 155 mm guns with vastly lighter ammunition, making it a better choice for many expeditionary type operations. It is being developed in both towed and turreted form, the latter already having been 'man qualified' in the course of demonstrations for the US Army.

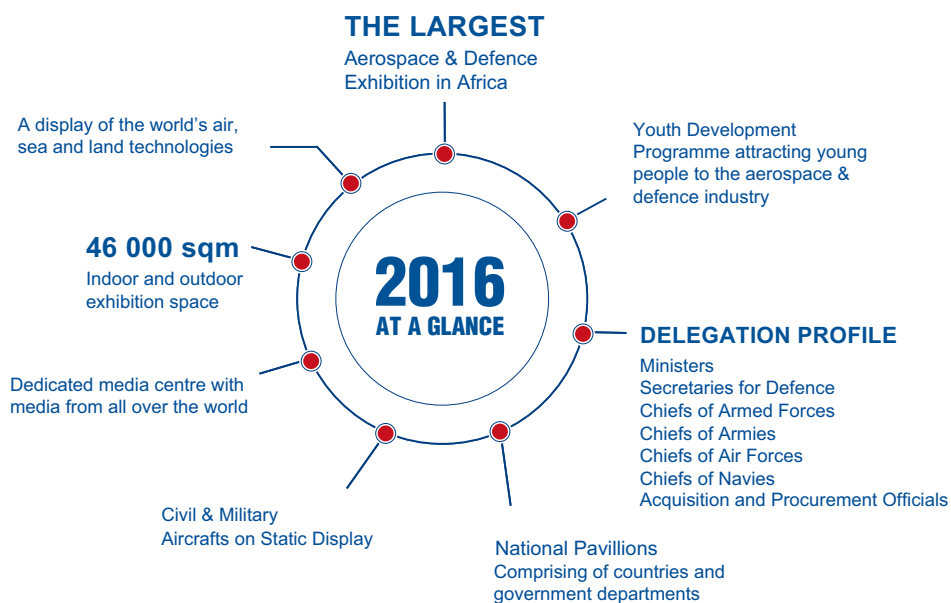
Ammunition is developed by Rheinmetall Denel Munition, with fuzes from Reutech's Fuchs Electronics. RDM exports ammunition widely, with the United States a major customer for artillery ammunition during the wars in Afghanistan and Iraq, another being India, and has also established munitions factories in several other countries, most recently in Saudi Arabia.

Infantry Support Weapons

Denel PMP, primarily a manufacturer and exporter of small calibre ammuni-



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Denel PMP's INKUNZI Personal Assault Weapon (PAW) is an alternative 40 mm grenade launcher in some applications, offering accurate fire out to 400 m and 600 m against larger targets, and suppressive fire to 1,000 m.



The ROOIVALK (shown here in service with the UN at Goma in the DRC) has never been exported; but sub-systems and weapons had earned ZAR 17 billion in exports by the end of 2013.

tion (infantry weapons to 35 mm cannon) has won two export orders, plus a repeat order from the first customer, for its 20x42 mm INKUNZI personal assault weapon. The PAW is an alternative 40 mm grenade launcher in some applications, offering accurate fire out to 400 m and 600 m against larger targets, and suppressive fire to 1000 m, with much lighter and smaller ammunition. It is being complemented with the belt-fed

INKUNZI STRIKE that weighs only 13 kg and will fit any mounting that can take a typical LMG.

DLS has had export success with its long-range (6,000 m) 60 mm mortar system, 40 mm automatic grenade-launcher and NTW anti-materiel rifle in 14.5 mm and 20x82 and 20x110 mm. Other actors are Milkor, which has sold some 60,000 six-shot and under-barrel 40 mm grenade launchers to 59 countries, and Rippel

Foreign Stakeholders

Atlas Elektronik (40% Cybicom Atlas Defence), Rheinmetall (51% Rheinmetall Denel Munition), Saab (100% Saab Grintek Defence), Turbomeca (51% Turbomeca Africa) and Zeiss (70% Denel Optronics, later Cassidian then Airbus Optronics). Cassidian (later Airbus) also has the majority share in GEW Technologies. Thales acquired Altech Defence Systems, but scaled that company down quite substantially.

Effect, which offers an extended-range launcher with medium-velocity ammunition developed by Diehl in Germany and Atlantis in South Africa. Another company, Truvelo, has been very successful with a range of sniper and anti-materiel rifles in calibres from 7.62 mm to 20x110 mm, as well as precision barrels. RDM is a major exporter of mortar and 40 mm ammunition, with fuzes from Fuchs and Atlantis.

Air Force Equipment

The major air force developments in South Africa were the ROOIVALK attack helicopter and the ORYX medium helicopter. While the latter was developed for local use and the ROOIVALK did not find an export customer, many of the systems developed for the ROOIVALK have proved successful internationally, with exports reaching ZAR 17 billion by 2014, among them INGWE and MOKOPA missiles, EO/IR turrets developed from its main sight, the self-protection system and the health and usage monitoring system (HUMS). Consideration is being given to launching a new ROOIVALK vari-



ant for the SA Air Force and, now that it is in full service and has proven itself in operations in the Democratic Republic of Congo, for possible export.

The most impressive development since the ROOIVALK is the AHRLAC surveillance and light attack aircraft. First developed at Aerosud by some of the engineers of the ROOIVALK project, it is in final development together with Paramount. The AHRLAC essentially combines the attributes of a rugged military turboprop aircraft with an attack helicopter-like stepped cockpit for good visibility and an under-cockpit weapons bay, and could prove useful in border patrol and counter-guerrilla operations. Paramount Advanced Technologies, in its former ATE guise, developed the weapons kit for Airbus Helicopters light helicopters, the first systems being exported to Iraq, and previously developed the SUPER HIND upgrade for Algeria.

Apart from the precision weapons already mentioned, Denel and Reutech also export aerial bombs in the full Mk 80 range, including pre-fragmented bombs and penetrators, as well as low-blast bombs for use in urban areas where collateral damage must be minimised, the Danish Air Force being a customer for the latter.

Aerosud and Denel Aerostructures manufacture components for the A400M and several other aircraft types, the latter manufacturing the fuselage top shells and the complex wing/fuselage fairings for the A400M. Denel Aviation is the OEM for the ROOIVALK attack helicopter and an MRO for the C-130 and L-100 and PUMA, SUPER PUMA, ORYX, A109, SUPER LYNX, AS350, Bo105 and BK117 helicopters, and supports several African forces. It also has a range of capabilities



The SEEKER 200 UAV was exported to Algeria and the UAE; the Seeker 400 is believed to have an export customer.

in supporting ground test and related equipment, project and programme management, and test flying. Turbomeca Africa supports not just the engines and gearboxes of the SAAF fleet, but also supports and refurbishes engines for other forces worldwide.

Naval Equipment

The industry is less active in the naval field, although the intention to build patrol vessels for the SA Navy in South Africa may see greater activity in the future. KND has designed patrol craft and Nautic and V-Craft (both owned by Paramount) have exported craft and vessels for naval or paramilitary applications. Reutech is active in some naval areas, RRS having exported naval radars, and Reutech Solutions having exported its ROGUE remotely-operated machinegun mounting to several countries. Saab Grintek Defence has exported its naval EW equipment, and Thales

South Africa is supplying the operations room consoles for FREMM class frigates. The CSIR has supplied sonar transducers for the Thales KINGKLIP sonar, which has been fitted to several foreign ships, among them the SIGMA class corvettes for the Indonesian and Moroccan navies.

Looking Forward

Assuming that the government pays heed to recommendations of the recent Defence Review, it should begin to offer the industry greater support, both financial from the defence and science and technology budgets, and in the form of financing assistance and streamlining the export control system. Given that support, the South African defence industry will be able to considerably expand its exports and continue developing equipment and systems that are effective, but that are also optimised for smaller armed forces. ■

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Hensoldt Ante Portas

After the Airbus Group's capabilities in the area of sensor technology had already been concentrated in a new company at the beginning of the year, Airbus DS Electronics and Border Security GmbH had its first public appearance on the occasion of this year's Berlin Air Show (ILA 2016). In this interview the CEO looks at the company's perspectives.

Photos: Airbus



Interview with Thomas Müller, Managing Director, Airbus DS Electronics and Border Security GmbH

Müller: The agreement with KKR for the sale of shares will take effect upon the so-called "closing" at the latest in the first quarter of next year, as soon as all the requirements, such as approval from the Competition and Markets Authority, have been met. At this time, we will introduce a clearly identifiable brand name for the company, derived from the name Moritz Carl Hensoldt, a pioneer of sensor technology.

We have, however, chosen the name Hensoldt not only for this reason, but far more because Hensoldt stands for technological innovation and outstanding achievement. This is a key value for all of our activities.

ESD: Have there been any changes in staff numbers and the product portfolio in the scope of the sensor house formation?

Müller: No. EBS, the future Hensoldt, has approximately 4,000 employees, around 3,400 of these at German sites. This means that we secure strategic capacities in the area of key national technologies as defined by the German government. Our core areas of expertise are radar, optronics, electronic warfare and mission avionics. In these areas, our products are represented as part of all the important platforms of the German Armed Forces. By bringing these technologies together under a single roof, we can take even greater advantage of the potential of sensor fusion to create more efficient sensor solutions. We want to continue increasing this capacity together with the German Armed Forces and our new shareholder.

ESD: What are the core competences that the company has today, at which sites does it operate and how big is the workforce? Are you in a position to give us revenue figures?

Müller: Without going into any great detail, I can say that our core competences are in the key technologies for intelligence and reconnaissance as defined by the German government. In other words, the technologies that are essential for performing military missions, for political leaders and military commanders to make their decisions and for the protection of soldiers in operations.

EBS generates annual revenues of approx. €1 Bn with the 4,000 employees already

ESD: Airbus DS Electronics and Border Security GmbH (EBS) was formed at the beginning of this year; in March, an agreement was signed for the sale of the relevant activities to the American investor KKR. What are the reasons for bringing together these Airbus DS activities in one independent limited company?

Müller: We have decided to combine the sensor technologies of Airbus Defence and Space with the associated electronics and to create a new sensor house outside of the Airbus Group since we are convinced that defence electronics will constitute a profitable growth market following its own laws. The best way for us to meet these special requirements is to enter the market without being dependent on a platform provider so that we can base our business model entirely on customer expectations. For this reason, we have to show more agility and pursue a categorical product strategy. KKR will help us to develop into a global Germany-based supplier of premium defence and security electronics that is not dependent on any platform.

ESD: At the moment, your company is still a wholly-owned subsidiary of Airbus and operates under the Airbus logo. When will you start operating independently?



The Airport Surveillance Radar Next Generation (ASR-NG) was first introduced last year. The sensor has range in excess of 200 km.



Utilising a 3-D geo-database the SferiAssist avionics system supports helicopter pilots at reduced visual conditions (night, fog, brownout, whiteout).

mentioned. Our main sites are: Ulm, Munich, Oberkochen and Friedrichshafen in Germany, Pretoria in South Africa and Elancourt in France.

ESD: At the latest since the deployment of German soldiers to Afghanistan the subject of "protection" has been given great priority in the military. What contribution can your company make to this? Are there any examples of systems and components currently being used?

Müller: We have already worked in this field for decades, primarily in the area of self-protection for rotary and fixed-wing aircraft. The Eurofighter's self-protection system and the missile warning systems used by the NH90 and Tiger helicopters are excellent examples of this. We are very successful on the international market in this area, where our MILDS missile approach warner is practically the standard sensor for helicopters and transport aircraft.

Of course, we also deploy our sensor capabilities to protect ground forces, for example in the active stand-off protection system of the new PUMA infantry fighting vehicle and in jammers for preventing bombs from being detonated by remote radio control.

However, you must always remember that sensors in general serve to protect soldiers during military operations because they can only neutralise threats if they are detected and identified at an early stage.

ESD: What current projects in the area of radar technology are relevant for the company?

Müller: In this area we have an extraordinarily "young" product portfolio. Just to mention a few examples – the latest TRS-4D naval radar is currently being installed on the F125 frigates and Lockheed Martin's Littoral Combat Ships; with our ASR-NG, we have the most powerful airport surveillance radar system in the world, and we

are responsible for the development of the antenna for Eurofighter's CAPTOR-E radar. We are forging ahead with the development of radar and protection technologies in close collaboration with the German BAAINBw procurement authority. Therefore, as THE German sensor house, we expect to play a key role in both the TLVS and the MKS180 projects as well as in the upgrading of the CH-53.

ESD: What prospects can you offer a young engineer who applies to Airbus DS Electronics and Border Security for a job today?



NightOwl M consists of an ATTICA M-ER type third generation thermal imager with an optimised megapixel detector and an eye-safe laser range finder. The progressive 200x optical zoom provides both for the detection of targets with a large and their identification with a small field of view.

Müller: The market for defence electronics is a growth market in which we have a leading position, that will be further strengthened. In view of this, we can offer not only an engineer, but also a skilled worker, excellent prospects in our company. We work on the boundaries of the physically possible, which means that there



The VPJ-R (Vehicle Protection Jammer) self-protection system makes an essential contribution to the protection of vehicle crews against IEDs. The system detects and jams up to 750,000 threat signals per second in all common frequency ranges.

are exciting technical tasks just waiting for an engineer. Moreover, we are multiply networked through international collaborations and have branches in many parts of the world, so if anyone is looking for

more experience in an international setting, then they have come to the right place. And last but not least – in our company, you will work in projects that literally save lives. There can hardly be a job with more responsibility. ■

The interview was conducted by Jürgen Hensel.

The Turkish Aviation and Space Industry

Korhan Özkilinc

The Turkish aviation industry has a long history and its beginnings reach back to the establishment of the Turkish Air Force (TuAF) in 1911.

The first domestic company, TOMTAŞ (Tayyare Ve Motor Türktaş), was established in 1925 in Kayseri and by the end of the 1940s a dozen aviation companies had been established, including an

Aerospace Locations

Structural development of Turkey's aviation industry is interlinked with the competitiveness of the defence industry as a whole. The goal of this cross-linking is to build vibrant, innovative areas on the basis of "clustering". In particular, these include two clusters in Ankara, OSSA SAVUNMA & HAVACILIK (160 companies) and ODTÜ TEKNOKENT (70 companies). The HUKD (42 companies) is in Izmir and the ESAC (30 companies) is found in Eskisehir. Both of these aerospace clusters

ment programmes of the State, and these will be reinforced through national ambitions and innovation awareness –but potential further improvements are not possible without external cooperation partners.

Fixed-Wing Aircraft Development

TAI, as the national aerospace company, has produced some 270 F-16 fighter jets, 60 CN-235 transport aircraft and dozens of helicopters under license for the Turk-



Photo: USAF

TAI built some 270 F-16 fighter jets under licence for the Turkish Air Force.

engine manufacturer: MRO has a long tradition in Turkey. However, due to a "wrong development policy" between the early 1950s and early 1970s the Turkish aviation industry was practically at a standstill, until its resurrection began with the establishment of TUSAS (Türk Uçak Sanayii Anonim Ortaklığı) in 1973.

Author

Korhan Özkilinc is an industry consultant specialising in international cooperation between high-tech companies, especially SMEs, and a regular contributor to ESD.

are globally well-positioned. Two further aerospace clusters are in development: the SAHA (106 companies) in Istanbul and the UHS (27 companies) in Bursa. Many companies disperse themselves across different clusters, but the crowning glory is "Ankara Aerospace Industrial Zone". This national project will be set up close to TAI (Ankara) on an area of 730 hectares. Two strategic aims will be achieved through this networked cooperation: the correct management of technology development, and supporting a sustainable value chain in the aerospace industries. The competitiveness of Turkish aviation companies broadly improved through ingenious and successful invest-

ish Air Force. In addition, between 1993 and 1995 TAI produced 46 F-16s for the Egyptian Air Force and modernised many more F-16s of the Pakistan Air Force. The TAI Maintenance, Repair and Overhaul (MRO) activities have gained recognition both nationally and internationally. More recently, TAI has begun specific promotion abroad through M&A, for example in Germany.

JSF F-35

Preparations for the procurement of 100 JSF F-35 are in progress, with the additional procurement of F-35B STOVL for the future Turkish LPD to take into consideration. Turkey is classified as a Level-3

partner in the consortium and plays an important role in the production process. Other Turkish enterprises have been explicitly launched for the F-35 programme, such as Kale Aero (JV between KALE and Pratt & Whitney) in Izmir: this company will manufacture many sensitive F135 engine components for the F-35. The 1st Air Supply and Maintenance Centre in Eskisehir was chosen as the MRO centre for F135 engines for Turkey, the Netherlands and Norway, and will provide services from 2018. In addition to TAI the following companies are important F-35 project partners: Kale Aerospace, Alp Aviation, Aselsan, Ayesas, Havelsan, Mikes and Roketsan.

HÜRKUS Basic Trainer Aircraft

An important milestone for the domestic industry was the agreement between TAI and SSM for development of the HÜRKUS Trainer project, which was signed in 2006. Flight testing and certification is being completed and the launch for the TuAF is planned for 2018. Different versions including a combat version with up to 1.5 tonnes payload (HÜRKUS-C) are in the final development phase.

TFX Turkish Fighter Experimental

At the end of 2010 the Defence Industry Executive Committee decided to develop an indigenous fifth-generation fighter. A group of indigenous and foreign teams is working intensively to integrate foreign expertise. A Letter of Intent was signed during IDEF 2015 Aselsan and Eurojet covering the intent to use the high-performance EJ200 engine in the new fighter jet, as used by the EUROFIGHTER TYPHOON. A JV between BAE Systems and Nurol Holding – Nurol BAE Systems Havacılık Sistemleri AŞ (NBA) – was established at the end of 2015 to address the TFX and other projects. Particular attention is being paid to the British lobbying capability in the USA.

A400M

TAI participates as a partner under the guidance of OCCAR in the manufacture of A400M military transport aircraft components –ailerons, spoilers, wiring and important fuselage components. Turkey is still involved in two OCCAR projects. The A400M is currently in service with the TuAF and earning great praise. The TuAF will acquire 10 A400Ms.

TR328

The resurrection of the Dornier DO328 as the Turkish Regional Jet was a big surprise!

These aircraft will be produced in Turkey in a jet variant, TRJ328, and as a turbo-prop, T328, for both civilian and military use. The US aerospace company Sierra Nevada Corporation Inc. has bought the license rights to both the DO328 and to the TRJet Havacılık Jetleri AS company in Ankara. The TRJ328 should be ready for launch in 2019, and its bigger brother, the TRJ628, ready for use in 2023. During development and certification two SNC subsidiaries, 3S Engineering and 3S Certification LLC, will be specially tasked. The prime contractor is the engineering

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service provider STM AS (belonging to the SSM, Savronik and Havelsan). Sub-contractors are TAI, Aselsan, TEI, Turkish Technic, Havelsan and others. It appears that a new aviation company has become established alongside TAI, suggesting that Turkey will operate in future with two spearhead aviation concerns. Although many analysts have declared this business venture to be uneconomical, decision-makers are optimistic because these development processes expand the domestic value chain and more importantly will catapult many Turkish SMEs to OEM supplier in the international aerospace market. Recently TRJet and TAI have started cooperation talks about narrow collaboration in developing the 628 series.

Rotary-Wing Aircraft Development

The geographical situation of the country and the functional structure of the armed



Photo: Airbus DS

As a partner TAI participates in the A400M military transport aircraft programme with manufacturing components.

forces make helicopters essential, so Turkey strives to build its own helicopters in Turkey through technology transfer.

T129 ATAK Turkish Advanced Attack and Tactical Reconnaissance Helicopter

At the end of 1995 TAI stated its intention to produce an all-weather two-seat combat helicopter. In March 2007 Agusta Westland was chosen as project partner

with the A129 MANGUSTA. Officially the start of the project was June 2008 and the first flight of the T129 (modified A129) was completed on 17 August 2011. The Turkish Armed Forces (TAF) received their first T129 on 22 April 2014. All in all the TAF will acquire 50 aircraft (+41 on option) in addition to expected orders from foreign countries. Some potential prospective customers exist in NATO. Many important components and weapon systems come from Turkish enterprises. For example, the MIZRAK and CIRIT rockets are from Roketsan. The twin high-performance LHTEC CTS800-4A engines will in the long run be manufactured in co-operation under licence by TEI in Eskisehir.

T70 Turkish Utility Helicopter Programme

Another procurement, for huge UHP programme, was decided in favour of Sikorsky Aircraft in April 2011. In February 2014 the contractual agreement between the SSM and TAI was signed for the production of 109 T70 helicopters (modified S-70 BLACK HAWKS). TAI is involved in this large-scale project as prime contractor and Aselsan and Sikorsky as the primary subcontractors. The UHPs will be produced by TAI; for some important components such as the avionics system Aselsan is responsible; and the powerful T700-TEI-701 engine will be manufactured under licence by TEI. The JV company of Sikorsky and Alpata, Alp Aviation, will also produce important components in Eskisehir. The project has started.

Indigenous Turkish Utility Helicopter Programme

In 2013 TAI and the SSM agreed a contract for the production of an indigenous utility helicopter. The new UHP should accommodate 14 –two pilots and up to 12 passengers. The first helicopters should start deliveries from 2020 and will probably follow the same strategy as the A129.

Photo: MTU Aero Engines



Assembly of an EJ200 engine at the MTU Aero Engines plant in Munich, Germany. This high-performance engine might be an integral component of a fifth-generation fighter developed by Turkish industry.



Photo: TAI

The ANKA-B UAV can operate for more than 24 hours at 10,000 m at a speed of about 100 kn.

Beside these prestigious projects, Turkish suppliers benefit from direct orders from abroad under offset obligations. An example is the CHINOOK CH-47F; in 2010 the SSM ordered six aircraft with five on option. Naturally there are other models in the Turkish government's procurement plans.

Turkey is a prime example of intelligent use of compensation strategies in international projects, using this principle to develop the technological abilities of its companies. But Turkey could secure its goals more quickly if a separate helicopter company were to be established within Turkey.

UAV Development

The importance of UAVs in the military field has risen significantly. Whether UAVs might replace fighter planes in the future is debatable, but air operations without “flying robots” are hard to imagine, and currently the world situation requires intelligent systems for symmetrical, asymmetrical and hybrid warfare. Market analysis suggests that many countries will be investing in the coming years in acquiring UAVs.

Turkey understood the implications of these remote systems early on, with TAI being ordered to develop an indigenous drone system in 2004, and in the last 10 years enormous progress has been made in the development of UAVs. Currently Turkey's most advanced UAV is the ANKA-B, which can operate for more than 24 hours at 10,000 m at a speed of about 100 kn. Tests are complete and recently the TAF received the first ANKA. Before the end of 2018 10 units will be delivered. Currently TAI is working on an armed version of ANKA-S, to be equipped in future with the UMTAS antitank missile and CIRIT laser-guided rocket system from Roketsan. In 2016 ANKA-S will get a new SATCOM System. TAI has developed ŞİMŞEK and TURNA as well as the smaller GÖZCÜ UAV for monitoring and as a target drone; these have been used successfully by the TAF. The future project is the "AKINCI – the Storm Rider", which will have an operating altitude of some 15,000 m and a greater payload. Development has mainly involved domestic industrial

al enterprises such as Aselsan, Milsoft, Savronik, SDT and STM. Two more indigenous companies develop tactical UAVs. One of them is Baykar Makina AS who are making great progress with the BAYRAKTAR TB2 UAV, which can operate fully autonomously from the start to the end of an operation, flying for 24 hours at up to 9000 m altitude. In December 2015 the company announced the successful launch of a MAM-L 22.5 kg precision-guided munition, specially developed by Roketsan for UAVs. Roketsan has also developed a smaller version, known as BOZOK, which weighs 9 kg. By the end of 2015 the company had supplied 12 rounds to the TAF, while the Turkish po-

lice department wish to order a further 12 or more. According to company information Baykar Makina use more than 90% self-manufactured components in their UAVs, and jet-powered UAVs are at the planning stage. In the next three years Baykar intend to develop different types of reconnaissance and attack UAVs featuring SATCOM, 40,000 ft altitude capability and up to 0.8 mach speed. It may be worth mentioning that the entrepreneur is the son-in-law of State President Recep Tayyip Erdogan.

The second company is Vestel Defence AS, which has developed the KARAYEL (Mistral) Tactical UAV and has delivered 6 pieces to the TAF. The company data

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Photo: TAI

The Turkish Armed Forces received their first T129 ATAK helicopter in April 2014.

suggests that the system can operate at altitudes up to 7000 m with more than 20 hours endurance carrying a 70 kg payload. Vestel also developed smaller versions: the BORA is used exclusively for avionics tests, and the EFE mini UAV is used for "close range investigation". There are at least three dozen companies in Turkey developing drone technologies and following the state's mandate for maximum use of "indigenous com-

ponents" in order to overcome reported problems with Turkey's Israeli HERON UAVs during the political crisis between the two countries. Through collaboration between the Ministry of National Defence, Ministry of Transport, Maritime Affairs & Communications and Türksat a new satellite research and development centre was established in Ankara. The new technology centre serves as the assembly, integration and test centre for satellites, testing Acoustics, Thermal Vacuum, Vibration, MLI, EMC and Solar Array Deployment. The centre offers manufacture of satel-

lites up to five tons, but the goal, under guidance of TAI, is to establish an effective value chain for the Turkish Space Industry. Besides TAI the following enterprises play a major role: Aselsan, C2Tech, Türksat, Roketsan and Tübitak Space Technologies Research Institute.

Since 1994 Turkey has satellites under its own management, gaining its first development experience in 2003 with the BILSAT. RASAT followed in 2011, and the first earth observation GÖKTÜRK 2 satellite was placed in orbit in 2012. The disputed GÖKTÜRK 1 satellite system will be launched before the end of 2016, followed by the GÖKTÜRK 3 and 4, equipped with Synthetic Aperture Radar, HR/EO and Hyperspectral Imaging capabilities. A historic milestone will be the communication satellite TÜRKSAT 6A, planned for 2021. National ambitions are very high: in less than 20 years the satellites will be launched with their own booster rockets (Roketsan has been assigned this task) and all this is in support of Turkey's aim of securing its position in the competitive and difficult space market.



Photo: Vestel

Six KARAYEL Tactical UAV developed by Vestel Defence AS have been delivered to the Turkish Air Force.

ponents" in order to overcome reported problems with Turkey's Israeli HERON UAVs during the political crisis between the two countries.

Space Development

Turkey has made enormous investment to reinforce its position in the region in terms of strategic and tactical information reconnaissance. The investment can be seen in the four B737 AEW&C, nine CN-235 Maritime Patrol/Surveillance and six (supply run) ATR72-600 Anti-submarine warfare airplanes. But of particular importance are the two 2015 openings, on 16 March, of the Radar and Electronic Warfare Technology Centre, and on 21 May of the Space Systems Assembly, Integration & Test Centre.



Image: gov.tur

The GÖKTÜRK 2 earth observation satellite was launched in 2012.

Conclusion

The Turkish aerospace industry has huge importance for the defence and security economy. It is also important for foreign companies by reason of the major interface between existing markets in the Middle East, Middle Asia and North Africa. But recent developments in domestic affairs could well impair industrial developments in the short term. After domestic restructuring measures aeronautical developments in Turkey will again pick up speed. ■

“The selection decision for a MEADS based TLVS in Germany has received considerable international interest.”

In the scope of the TLVS programme the German Air Force plans to implement a new and extended air defence capability based on the results of the tri-lateral MEADS development programme. ESD spoke with Siegfried Bücheler, Member of the Board of MBDA Deutschland, the expected industrial prime contractor.

Photos: MBDA



**Interview with Siegfried Bücheler,
Member of the Board of MBDA
Deutschland**

ESD: MBDA Deutschland will be prime contractor for the MEADS-based Tactical Air Defence System (TLVS). It is understood as being one of Germany's and MBDA's priority programmes. What is the status of this effort from MBDA's perspective?

Bücheler: In February 2016, MBDA Deutschland received a complete Request for Proposal for the German TLVS/MEADS. We are currently working on the proposal. After contract negotiation and parliamentary approval the German procurement office BAAlNBw can award a contract to MBDA Germany. At the ILA Berlin Air Show the MEADS equipment was presented in the German Bundeswehr's own display. Bundeswehr personnel also explained the equipment to international delegations as well as representatives of parliament and government.

ESD: You emphasise that, in comparison with competitive systems, TLVS can offer more capability at lower cost. Can you elaborate on that?

Bücheler: MEADS based TLVS incorporates 360-degree radars, networked battle management with an open architecture

and a plug-and-fight interface to optimise interoperability, easily transportable launchers and an interceptor mix, with the hit-to-kill PAC-3 MSE missile and the IRIS-T SL as secondary missile, to defeat the entire threat spectrum, including cruise missiles, tactical ballistic missiles and air-breathing threats. To reduce support costs, TLVS will allow the German Air Force to save 50% of manpower and reduce maintenance significantly in comparison with current systems. TLVS will offer the needed growth potential, to enable future enhancements.

ESD: What effect do you expect from the German TLVS selection on other markets with similar requirements, like Poland, Italy and Turkey?

Bücheler: Countries that have already chosen a competing system are now reconsidering their decisions in view of the unique performance capability of this new system. The selection decision for a MEADS based TLVS in Germany has received considerable international interest.

All nations in NATO Europe have recognised the increasing threat in the air and missile defence domain. Various countries

are currently preparing decisions for their future ground-based air defence capabilities, among them Poland, Sweden, Turkey, Switzerland, and others. With the substantial performance in mind, these countries show interest in TLVS/MEADS.

We continue to see strong interest in MEADS from both Turkish government officials and industry. In fact, Turkey's requirements are very similar to Poland's. They want an advanced capability and significant industrial participation, with technology transfer that can be tailored to their specific needs.

ESD: Considering the fact that this issue of the magazine will be distributed at the forthcoming MSPO exhibition in Kielce, Poland, what is your "message" to the Polish military and defence administration?

Bücheler: Poland and Germany have become close partners in recent years. Today, Germany is Poland's most important trading partner, taking more than a quarter of its exports. Poland is also Germany's eighth largest economic partner.

Defence and security is another aspect. Both Poland and Germany have long been



German TLVS/MEADS configuration at the ILA Berlin Air Show 2016

planning on modernising their air defence capabilities. Both countries have been in discussions at defence ministerial levels for some time, and both have stressed the NATO-interoperability of their national air defence systems. The time has come for Germany and Poland to lead by example and show as partners that defence matters.

ESD: How do you plan to cope with offset requirements in terms of direct and indirect compensation in Poland?

Bücheler: In Poland, the newly elected government has been questioning the high cost, risk, and lack of meaningful technology transfer offered by the PATRIOT system in the scope of the WISLA programme.

This year, the Polish MoD wants to reopen its dialogue with MEADS after restating that the most important aspects of WISLA are 360-degree capability, high mobility, open architecture, and plug-and-fight capability. They also want a high level of industrial cooperation at a fair price and schedule. MEADS is well positioned to meet these needs.

Since February, the MEADS International team has been actively engaged in discussions with the MoD to include detailed discussions with the Polish Offset Office and Polish industry. And we are absolutely glad to be talking in Poland again! As in Germany, all we ask for is the opportunity to demonstrate what MEADS can provide in an open competition.

Because the system is already proven, MEADS addresses both Poland's military requirement and budget. And potential savings and increased security are available in a joint programme with Germany.

ESD: What does the decision for TLVS/MEADS mean for Germany's strong role in NATO air defence?

Bücheler: Germany qualified the threat as important enough to make ground-based air and missile defence and the MEADS-based TLVS procurement one of its three priority procurement programmes. This

is sending a strong signal. With TLVS/MEADS, Germany will strengthen and expand its role in the area of ground-based air and missile defence within NATO.

The open system architecture of TLVS/MEADS creates the technical basis for Germany to fulfil its current and future NATO obligations and present itself as a nation offering a framework for air and missile defence. With Germany as Framework Nation, the path forward provides an oppor-



MBDA's 360-degree new laser effector

tunity to spread the TLVS/MEADS capability NATO-wide, and nations are beginning to see the benefit.

Nations including Hungary, Romania, and the Baltic States have expressed strong interest in air defence cooperation using MEADS.

MEADS can be tailored to a nation's financial capabilities and the components they already have. With a limited investment, they gain the opportunity to be involved in the NATO air defence umbrella.

Having a component based system like MEADS is a game-changer – nations can procure networked components as budget allows and still contribute to NATO air and missile defence.

ESD: Another future-oriented development field of MBDA is in the area of laser weapons. What are the advantages of this technology and what remains to be done to implement it for series production?

Bücheler: We consider the protection against unmanned air vehicles and counter rocket, artillery and mortar (C-RAM) defence to be among the most important applications for laser weapons in the near term. Also, in the context of naval counter-piracy operations, laser weapons will find their role. As far as the engagement of UAVs is concerned the advantages include low costs, selective effects from blinding the seeker to destroying the seeker, and ultimately destruction of the target. The laser is also silent and produces no bullet casings to cause damage on the ground: this is particularly important for the protection of civilian events and facilities against UAV deployments. Generally speaking, the unparalleled advantages of lasers are their precision and the seamless scalability, along with the avoidance of ammunition and related logistics.

The laser technologies exist. Our new laser effector is based on a multi-stage, highly precise tracking procedure. It provides high performance density from one effector. These processes make it possible to combat small, highly agile targets reliably with a single laser effector. The effector can be fit onto relevant tactical platforms, no matter if it is a ship or a ground based platform, and can provide full 360-degree coverage. With this laser system, MBDA Deutschland has made a dedicated step towards an operational system. With appropriate investments our laser weapon system will be operational in a few years. ■

The questions were asked by Jürgen Hensel.

Anniversary of Helmet Mounted Displays

(df) Elbit Systems of America and Rockwell Collins marked the 20th anniversary of their highly successful Helmet Mounted Display (HMD) joint venture in a special board meeting in Fort Worth, Texas. "Today we celebrate the partnership of two of the world's

Photo: Elbit Systems



top avionic systems providers," said Elbit Systems of America's President and Chief Executive Officer Raanan Horowitz, at the event. "The incredible synergy created by this combination has resulted in RCEVS becoming one of the leaders in HMD solutions for military fixed-wing aircraft." The HMD serves as the virtual Head-Up Display (HUD), enabling the F-35 to become the first tactical fighter in 50 years without a traditional HUD. Since forming the joint venture in 1996 to provide helmet mounted displays for fixed-wing military aircraft, Rockwell Collins ESA Vision Systems LLC (RCEVS), has delivered thousands of Joint Helmet Mounted Cueing System (JHMCS) HMDs across the world for F-15, F-16 and F/A-18 advanced cockpits. RCEVS JHMCS HMDs are now flying with more than 20 air forces around the world. These provide accurate cueing of targeting systems wherever the pilot looks versus the traditional HUD which is limited to a narrow, forward-aiming cone.

Airbus Helicopters and Mahindra Team for Indian Naval Helicopter

(df) Airbus Helicopters has awarded a contract to Mahindra Aerostructures to make airframe parts for the AS565 MBe PANTHER. These parts will be produced at the Mahindra facility in Bengaluru. They will be shipped to the Airbus Helicopter production line in France where they will be integrated with the rest of the airframe assembly and be part of the PANTHERs sold worldwide. "We are playing an active role in the development of a helicopter-focused Indian industrial ecosystem, and are embedding Indian suppliers into our global supply chain," said Fabrice Cagnat, Director – Make in India, Airbus Helicopters. "This allows us to qualify Mahindra

TechNet Europe 2016

AFCEA, the Association for Communications, Electronics, Intelligence and Information Systems Professionals, is celebrating its 70th anniversary in 2016. AFCEA Europe – an extension of the AFCEA International Headquarters – organises events in Europe and promotes education – all with the purpose of equipping its individual and corporate members to meet governments' challenges and to further their careers. AFCEA Europe's annual second flagship event, which is this year the "Jubilee TechNet Europe 2016" will be organised under the patronage of The Netherlands' Ministry of Defence and with the support of AFCEA's The Hague Chapter. Also supported by NIDV (Netherlands Industries for Defence & Security) and VID (Defence IT Experts Association), TechNet Europe 2016, will be held on the SS Rotterdam Cruise Hotel from 3 to 5 October under the umbrella theme "Changing the Game in Security – Key Role for C4ISR". An industry exhibition will be set up to allow a close look at leading-edge hardware and software applications related to the conference theme.

Confirmed keynote speakers:

- RADM Maarten Tossings, CIO, Ministry of Defence, The Netherlands
- Mr. Terry Halvorsen, CIO, Department of Defence, USA
- MGEN. Koen Gijssbers (Ret.), General Manager, NATO Communications and Information Agency
- Mr. Rini Goos, Dp Chief Executive of the European Defence Agency
- Mr. Murray Davidson, Director of Strategy, NATO Communications and Information Agency
- BrigGen Dr. Michael Färber, Dp Commander, CIS Command, Germany
- BrigGen Hans Folmer, Commander, Cyber Command, The Netherlands
- Prof. Dr. Holger H. Mey, Honorary Professor for Foreign Policy, University of Cologne

Four special theme tracks will deal with:

- From Joint ISR to Network Operations;
- Serious Gaming becoming Professional;
- Tactical Networking in the Mobile Domain;
- Cyber, what else?

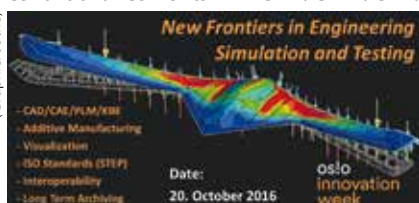
Beyond that, it is planned to run a Student Conference to bring together young students and faculty staff from all over Europe to work on themes related to their studies, as well as supplementing the overall conference theme.

Please get engaged and decide on an active participation in TechNet Europe 2016. Registration and hotel booking are now open and the latest programme is available on www.afceaurope.org (click on "TechNet Europe 2016").

Aerostructures as a Tier 1 supplier, establish a manufacturing relationship with them on the PANTHER, and also lay the ground work for a rapid acceleration in terms of industrializing production in India, in case we are selected for the Naval Utility Helicopter programme." As announced earlier, Airbus Helicopters and Mahindra Defence are in the process of forming a joint venture to target India's military helicopter programmes such as the Naval Utility Helicopter, the Naval Multi-Role Helicopter and the Reconnaissance and Surveillance Helicopter. The AS565 MBe PANTHER is competing for the Naval Utility Helicopter programme.

New Frontiers in Engineering Simulation and Testing

(df) Jotne will conduct a seminar on the subject of "New Frontiers in Engineering Simulation and Testing". This seminar aims to help companies explore new capabilities in simulation and test data management, and how to use ISO standards to increase the interoperability of engineering and PLM/ILS information. Speeches will highlight recent advancements in CAD/CAM/CAE/



Graphic: Jotne

PLM, including additive manufacturing that enables standards-based product lifecycle management, with presentations given by Lockheed Martin, Jotne, Eker Design, NTNU, Norwegian Defence Research Establishment (FFI), SINTEF and EU/I4MS in addition to an interactive demonstration session at the end of the day. The seminar will be on October 20, 2016 in the Oslo Military Society in Oslo, Norway.

Gottschild New Managing Director of MBDA Deutschland

Thomas Gottschild follows Thomas Homberg as Managing Director of MBDA Deutschland GmbH and Executive Group Director Improvement. He will also be a member of the MBDA Executive Committee. The appointment is effective immediately. Antoine Bouvier, CEO of MBDA said: "I am extremely pleased to welcome Thomas Gottschild within MBDA. Thomas joins MBDA from Airbus Defence and Space, where he has held a number of leadership positions in a variety of domains, including engineering, programmes, commercial, business development, strategy, and most recently as Corporate Secretary. I'm sure that Thomas will be an asset for MBDA and decisively contribute to the success of the Company." "I am looking forward to this new task."



Photo: MBDA

I have followed the development of MBDA Deutschland with great interest. MBDA Deutschland has an outstanding team of employees with huge and long standing experience. It is my main task as Managing Director to boost the implementation of TLVS/MEADS and to meet the challenges ahead together with the MBDA-Team," said Thomas Gottschild, new Managing Director of MBDA Deutschland.

NATO Invests €3 Billion in Cyber

(df) The NATO Communication and Information (NCI) Agency announced business opportunities in cyber, air and missile defence as well as advanced software, worth €3 billion. This comes in parallel to decisions taken at the Warsaw Summit to strengthen the Alliance's deterrence and defence. The investments are planned between now and 2019 with first contracts having already been put out for tender. These will include: a major contract for NATO satellite communications worth €1.5 billion, the procurement of advanced software and a further strengthening of NATO's air defences. Other contracts for future programmes will include cyber defence, command and control for complex operations and the Response Force. "The ingenuity and creativity of our private sector has always been a source of strength for NATO," said Koen Gijssels, NCI Agency General Manager. "We, as an Alliance, have been able to maintain our technological edge over our adversaries for 67 years because the innovative capacity of our pri-

mate sector is unparalleled. Today's technological change is driven by Industry and as NATO we are engaging Industry early on to ensure we tap into that creativity. NATO will only be resilient if we embrace and can do continuous, rapid innovation." He added: "The contracts we're announcing focus on one of the core tasks of the Alliance, to connect and link national forces and capabilities into a whole that is greater than the sum of its parts. By linking and connecting individual national capabilities NATO can do more than individual countries could do themselves."

Kongsberg and Raytheon Team for the Naval Strike Missile

(df) Raytheon and Norway's Kongsberg Defence Systems are finalising plans to assemble, integrate and test the Naval Strike



(Photo: Raytheon)

Missile (NSM) in the United States. The two companies also plan to produce NSM launchers in the US. With a range of more than 100 nautical miles, NSM is a long-range anti-ship missile that provides superior strike capability against land and sea targets. Raytheon and Kongsberg believe

NSM is an ideal solution for navies around the globe and the best over-the-horizon missile for the US Navy's Littoral Combat Ship. "NSM production in America is the latest evolution of our decades-long relationship with Kongsberg," said Dr. Taylor W. Lawrence, Raytheon Missile Systems President. The companies are also teamed on the development of the Joint Strike Missile and National Advanced Surface-to-Air Missile Systems, also known as NASAMS. "Production of NSM in the United States will secure ramp up and sustainability of NSM, the world's only Fifth Generation Naval Strike Missile with Land Target capabilities, for the US and our allies," added Harald Ånnestad, President Kongsberg Defence Systems.

Forcepol Clients at MSPO

At MSPO this year look out for the clients of Forcepol. Having enjoyed outstanding sales success domestically and on the export markets, these companies will be gearing up for the major 2017 exhibitions starting with IWA and IDEX and extending through to DSEi and beyond. The companies include producers from all around the world: Prototypa-ZM (CZ), Fireco S.r.l. (IT), Scandinavian Avionics A/S (DK), IKey, Ltd.(USA), EDH Doppler Pty LTD (ZA) and others

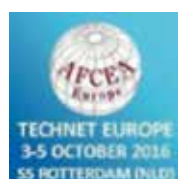
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Poland

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