

UDT 2019 to provide international perspectives



The 32nd edition of UDT in Stockholm comes at a crucial time for the continent and the militaries that defend the region and beyond, in light of a resurgent Russia and tightening budgets – industry's efforts in producing holistic, advanced and economic underwater defence technologies are now more crucial than ever.

This is represented by the growth in the number of new companies attending, with almost 40% of exhibitors fresh to the event in its entirety, reflecting the significance of this area to military requirements. UDT 2019 has grown relative to 2018's event by 3.2%.

Being located in Sweden naturally has its draw, due to its Baltic coast and the global defence and security challenges that face this region now and into the future. Such matters, addressed in the nation's Defence Policy 2016-2020, are providing a talking point for industry at the event.

Whilst UDT is focused on the technologies that enable military personnel to conduct operations, it also emphasises, particularly at this year's event, the demands placed on the individual operator and the challenging and dangerous situations that combat divers can face.

A themed strand of UDT 2019 looks at military diver capabilities, from penetrating the depths of the ocean to the weight of breathing equipment, with personnel spanning the services, and crucial for intelligence, security and recovery missions.

The Military Diver Capabilities conference will cover a range of topics: advanced combat diver

navigation and autonomy; undersea communications; portable sonar systems for EOD and salvage; as well as augmented-reality HUDs for zero-visibility dives.

In addition to the display of new technologies, the conference, on 14 May, will also provide a forum for inter-service and international diver units to meet and discuss the challenges of operating in the most inhospitable of environments.

Ahead of this, the UDT 2019 keynote address by RAdm Jens Nykvist, Chief of the Royal Swedish Navy, kicks off proceedings on 13 May and will be followed by a panel discussion on 'Total Defence: Undersea Defence and Security in a Deteriorating Global Environment'.

Simon Williams, chair at Clarion Defence & Security, commented: 'This year's keynote speakers will provide an insider view of both the Swedish outlook and a truly international perspective on training and simulation, undersea technology and EW requirements as we look toward the coming decade.'

Notably, this year's UDT is co-located for the first time with AOC EW Europe and ITEC 2019. Spanning the three co-located events, 6,000-7,000 attendees are expected across the week.

'With all three events co-located under one roof in Stockholm this year, attendees will have the opportunity to hear from some of the top commentators currently operating in their respective fields,' noted Tracy Bebbington, Event Director, Clarion Defence & Security.

By Helen Haxell

DAY ONE

13 May 2019

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In the training world, AI is attracting attention and dividing opinions because of the enormous capability it brings.

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JFD Sweden dives deep into UDT 2019

STAND D29

JFD Sweden sat down with the UDT Daily News to discuss the focus on military diving capabilities at this year's event, and what the company can bring to this arena.

Anders Magnerfelt, MD at JFD Sweden, said: 'UDT is strongly focusing on technology and innovation and we try to be a lead company in this, so it's important for us to engage in [the show].'

He recognised that the event has moved away from a primary focus on submarines, and military diving capabilities have come to the forefront of UDT's programme because their increased application is becoming significant.

'We are now seeing that there is significant growth in navies looking to develop specific American skills for special operations, for counterterrorism and other areas of covert operations,' he said.

This focus on diving also reflects the role that industry can play in shaping future technologies, and how companies and militaries can learn from each other in the use of new systems across these types of operation.

'It's an underwater technology exhibition, so that is why it's natural that the people in these areas comes together to speak about and communicate around the development of different technologies.'

These types of mission, for both special forces units and regular navies, are intricate and present real dangers. Magnerfelt commented: 'Military divers often carry out complex missions in challenging environments with high risks where the cost of any error or incident can be severe. Safety and [operational security] are paramount to requirements today.'

The challenges encountered on these missions vary according to circumstances, but safety of operations for divers and providing sufficient endurance to complete the task are recurring themes.

'We have very good systems to get a diver underwater and to perform underwater, but the endurance is limited and that's an area where I hope that we together can reach forward,' Magnerfelt said.

In January, JFD launched a flexible, back-mounted defence rebreather unit called Shadow/B for military combat divers (pictured).

Shadow/B, combined with a conversion kit, allows divers to switch from a front-mounted to a back-mounted rebreather. The conversion enables operators to use the rebreather in back or front-mounted configuration as per the mission requirement.

It is a pure oxygen rebreather with over-the-shoulder counterlungs and



Photo: JFD

a back-mounted scrubber, utilising a 200-bar cylinder charge. The system's counterlungs incorporate an automatic demand valve that also serves as a manual bypass facility.

Magnerfelt spoke with Helen Haxell

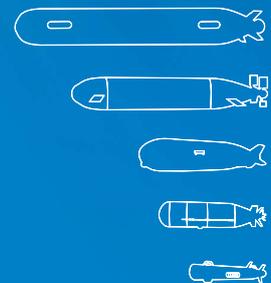
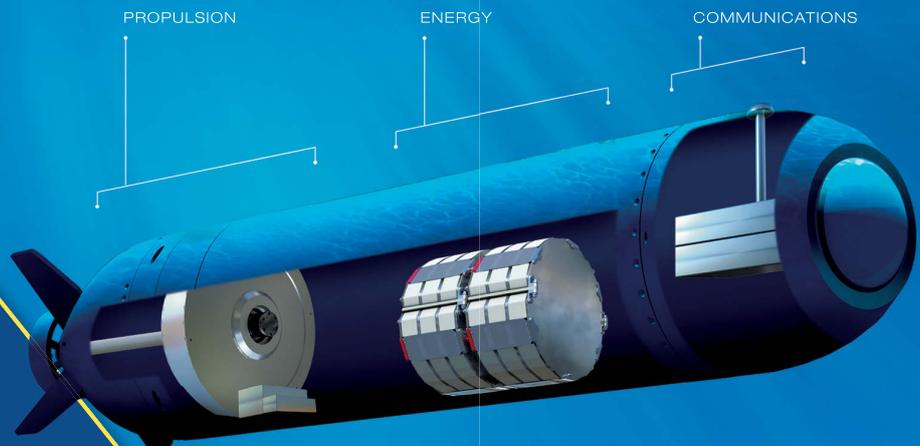
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GENERAL ATOMICS
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New Wyvern submarine concepts to be unveiled

STAND D18

UK naval design firm BMT is planning to present new models of its Wyvern submarine concept at UDT 2019.

In addition to a new coastguard variant (with deck gun) that will be introduced during the conference, there will be a 'high-risk' evolution of the initial 'low-risk' concept.

BMT launched Wyvern in 2017 and has since been using it to work out how different technologies could operate on future submarine platforms. Ian Parker, senior principle engineer at the company, said: 'Wyvern for us has been an excellent success.'

BMT told *UDT Daily News* that the main focus of the concept is having a submarine which, in a crowded market for conventionally powered boats, offers large amounts of capability without pushing up the size of the vessel and therefore cost.

The new higher-risk concept features lithium-polymer batteries mounted outside the hull, freeing up

space inside for weapons and other payloads whilst placing a greater emphasis on UUV launch and recovery.

BMT's senior naval architect, David Morris, said: 'One of the key technologies that is holding this back is launch and recovery. There has been a lot research into launch and recovery of UUVs from ships, but there has been less research of launch and recovery from submarines.'

'We wanted to take Wyvern, which is an open-source design and explore what a submarine would look like that would launch and recover UUVs.'

Hydroid provided a Remus-model UUV for trials, and the company plans to continue its research on how submarines and UUVs interact.

BMT has previously displayed its Vidar (36 and 7) and SSGT concepts, the latter of which uses an innovative hydrogen propulsion system. Some of this work is continuing, as Wyvern could have an air-independent propulsion Stirling engine.

By Jack Richardson

Scorpène sub solution proposed for Poland

STAND A4

As competition for Poland's submarine replacement programme continues, France's Naval Group considers its Scorpène-based solution capable of providing the country with NATO's most powerful conventional fleet.

Naval Group has achieved success with its Scorpène SSK design in Brazil and India. The conventional-powered Barracuda variant, a derivative of the nuclear-powered French model, was also selected by the Australian Navy.

Polish officials have continued to highlight the procurement of new submarines under the Orka programme as one of the navy's top ongoing priorities. The three contenders are Naval Group, Saab and Thyssenkrupp Marine Systems.

Naval Group has previously indicated that it will be able to involve around 100 Polish

companies and also include technology transfer to the country.

A spokesperson said: 'With the Scorpène-class submarine equipped with the same armament as the last-generation French... Barracuda, the Polish submarine fleet will have the same combat capacities as the first NATO navy in Europe.'

'What Naval Group proposes to the Polish Navy is to help it to become NATO's most powerful conventional submarine fleet. Our submarines are a real empowerment tool and will enable Poland to take its rightful place in Europe's defence.'

The spokesperson added: 'With our solution, Poland will acquire a credible military capability that will strengthen its position within NATO and ensure Poland's capability to enforce its sovereignty on the Baltic Sea.'

By Beth Maundrill, Jack Richardson and Richard Thomas

ITAR-free SeaNav is all EARs

Photo: Kearfott



The T24 SeaNav is a modular solution to enable a wide array of surface and sub-surface vessels (manned and unmanned) to safely navigate under all conditions whilst ensuring their subsystems

remain stable and reliable.

A move to the EAR regime means regulation comes through the US Department of Commerce. This list is reserved for items with dual uses for both military and humanitarian operations, therefore allowing for more liberal export controls.

Andrew Continisio, product line manager for SeaNav 24, explained to

UDT Daily News the difficulties caused by the previous ITAR regulations: 'Lots of people went away from our product because of [the previous stance].'

The existing licence is cancelled for each example of the product produced and a new one is issued once the modification is complete.

For existing customers this involves returning the modules to the factory to enable modification to bring them beneath the threshold for which ITAR certification is required, although Continisio was keen to stress effectiveness is not compromised.

It took the company eight months from applying for the licensing change to it being granted.

By Jack Richardson

STAND C5

For one company, exporting key devices is about to become easier. Kearfott Corporation has successfully had its T24 SeaNav solution removed from ITAR regulation and into the more flexible Export Administration Regulation (EAR) regime.

French frigates get sonar retrofit

STAND E7

As part of the French MoD's Frigate Sonar Capacity Upgrade programme, four French Navy frigates have seen their analogue sensors modernised by RTsys.

The upgrade comprises RTsys's AS3i (Analog Surface Ship Sonar Improvement) technology with a Synchronous Data Acquisition system. The suite digitalises and processes signals received without the need to modify existing transmitters and transducers.

According to a release, it has been installed on three ASW frigates in Brest and on an anti-air warfare frigate based in Toulon.

The modernisation aids crews through enhancement of signal processing and the added capability to 'mark objects and follow them'.

By Helen Haxell

NATO takes GEOINT initiative

Photo: NATO



NATO is taking a renewed interest in GEOINT with the next few years seeing a number of key technological and tactical developments for the field within the alliance.

Speaking in January, Dr Giorgio Ciori, director of armament and aerospace, capability area manager for joint ISR, within NATO, outlined a

series of future projects and developments for the alliance.

For instance, before summer 2019 NATO is scheduled to receive the first of first five Global Hawk remotely piloted aircraft (pictured). These will comprise the first ever organic intelligent collection platform for the Alliance Ground Surveillance system providing both

synthetic aperture radar and ground moving target indicator capability.

NATO is also working towards developing a GEOINT policy to provide coherence and interoperability within its organisational structure.

The policy would establish order and direction in intelligence production as well as resource handling, plus coordination of capabilities and entities which may not be specifically assigned to NATO. However, this is yet to be agreed by the organisation's members.

The alliance is also planning technological advances in the field. By the end of 2019 a 3D version of a viewing application will be launched.

By Kate Martyr

Russia bolsters long-range EW

The Russian MoD has reported completion of the first deployment phase of a multi-level EW radar network.

The four newly commissioned radar systems are intended for detection and tracking of air and space targets well beyond Russia's borders, and provide overlap of the monitored airspace sectors. A second phase will see deployment of four more systems.

According to *Izvestiya*, citing MoD sources, the most important event in this first phase, reported in December 2018, is the commissioning of the 29B6 Container over-the-horizon radar system at Kovytkino, 400km southeast of Moscow, which was placed on 'experimental combat alert' duty. The system is set to be declared fully operational for combat alert by mid-2019.

By Alexander Mladenov

Bird SPREOS production configuration showcased

STAND C6

Bird Aerosystems will present its Self-Protection Radar Electro-Optic System (SPREOS) compact DIRCM at AOC EW Europe 2019.

SPREOS will be showcased in its production configuration, which combines a radar-based confirmation sensor and active laser jammer, and ensures optimal protection against different MANPADS threat types, according to the Israeli manufacturer.

SPREOS slews to the direction of the threat, activates its multi-band radar functionality, confirms and tracks while analysing information to enable the most effective jamming response.

Following confirmation and tracking, SPREOS deploys a dual-band countermeasure laser, causing the missile to miss the aircraft.

Bird has designed SPREOS to be compatible with a range of airborne platforms.

'Combining multiple independent laser generators, including the latest QCL technology, and utilising proprietary multi-band laser jamming, Bird's

SPREOS eliminates all of the false alarms and ensures that only actual threats are jammed,' said Ronen Factor, co-CEO and founder of the company.

'Uniquely designed to protect military and civilian aircraft against the growing threat of ground-to-air MANPADS, Bird's SPREOS can be easily integrated with all types of missile warning systems, and is the most compact and cost-effective DIRCM available today.'

During AOC EW Europe, the company will also present its Missile Approach Confirmation Sensor (MACS). This performs unique confirmation of suspected incoming threats detected by the main EO passive sensors, and practically eliminates any false alarms.

Simultaneously, MACS collects relevant information on the target (velocity and distance) and calculates its time to impact, enabling effective countermeasure response to the incoming missile. MACS ensures that only real missiles will be declared by the system and reacted upon.

By Beth Maundrill

TMD receives TWT order for NATO operations

STAND C16

Manufacturer of professional microwave and RF products TMD Technologies has received an order for its latest portfolio of Ka-band travelling wave tube (TWT) microwave power modules (MPMs) for deployment in a NATO role.

The latest Ka-band TWT MPM from the UK-based company is the PTX8807, joining the PTXM2000 compact high-power MPM and solid-state PTS6900 as well as other ultra-compact TWT-based modules from the PTXM Series, which will be on display at AOC EW Europe 2019.

The PTX8807, according to a company release, provides countermeasures against operational systems increasingly emerging in the Ka-band, for instance missile threats. The company has received an order of four units of the hardware for

use in a naval multi-MPM EW jamming system in a NATO role, TMD has said.

The technology covers the 30-40GHz Ka-band with a power output of 200W and is easily integrated into EW and radar systems, it stated.

The system has the capacity to be mounted on a range of airborne platforms due to its ability to operate in humid conditions as well as at high altitude.

Nigel Hann, head of sales at TMD, commented: 'TMD has extensive experience in the manufacture of EW/ECM and radar products for airborne, ground-based and naval platforms.

'Our latest EW products include a range of units covering the technically challenging Ka-band as well as utmost-reliability, high-power options for the 6-18GHz frequency range,' he added.

By Helen Haxell

AOC faces up to Euro threats

Muddy Watters, AOC president, spoke with AOC EW Europe Daily News to discuss the main EW challenges in the European region and the technologies presenting themselves as the solution.

It is hardly a surprise that the major EW theatre threat facing Europe is Russia. Watters explained that Moscow has access to major defensive and offensive weapons systems along with long-range air defence, tactical radio, unmanned ISR, SIGINT, COMINT and EW capabilities at its disposal.

'[Russia has] also reorganised and retrained its EW forces and embedded its EW units within its larger force. We've seen a significant use of electronic warfare by the Russians, to include synchronised signals, intelligence information, operations, jamming and the use of directed energy weapons.'

Maintaining a base

However, this is not an isolated issue, and Watters shared that one of the other prominent EW problems facing the continent is the region's capacity to maintain its industrial base.

Whilst Europe's focus has turned to counter-terrorism due to recent internal threats, Watters suggested that this has left an imbalance in the EW technology portfolio.

Now is the time to look at meeting the demands posed by air defence systems and comms networks, he urged.

'This is going to require a broad investment in EW/SIGINT technologies and I'm not sure that Europe's political leaders are really aware of this.'

He continued: 'The other thing is that equipment is not enough. I think Europe must continue to develop multinational concepts of operations – so, working together, training as a coalition. And really what that emphasises is minimising barriers to interoperability and compatibility, and that goes for all their systems.'

Counteractive capability

For Europe to truly address the threat posed by Russia in an anti-access/area-denial sphere, EW technologies in the air domain need to support jamming systems (stealth aids, self-protection suites) and these capabilities can counteract Russia's long-range radar and missiles, Watters commented.

Invoking all three domains of air, sea and land, Watters referenced 'a new era' where, in the skies, cyber capabilities are explored to disrupt networks.

'On the ground we've got communications jamming. We've got offensive cyber capabilities and those are needed to disrupt and degrade the communications networks. We've also seen an upsurge in UAS. So, we need to really focus on counter-UAS systems.'

'They can take the eyes away from the Russian forces and limit the ability



Image:
US DoD

to employ their long-range artillery. If we move to the naval side, we've gotten modern shipboard EW systems that need to be there to enable naval forces to operate in the constrained maritime environments of the Baltic Sea.'

Development drive

Looking to the future, and the next generation of technologies which could populate EW frontiers, Watters volunteered that there are three strands of development which will shape the evolution of EW.

Starting in the near future, he shared that it was likely to be multifunction electromagnetic systems that will be applied to a variety of weapon platforms in a range of sizes.

In particular, AESA radars have the capacity to handle multibeam shaping and functionality, or at the smaller end of the spectrum there is the reduction in antenna size which, in turn, will see a further reduction in RF signatures 'on large complex weapons systems like frigates and aircraft carriers'.

He added: 'And on the other end of the spectrum, these multifunction systems can perform radar, data link, and EW functions all maybe concurrently, and that's going to help enable small unmanned platforms to perform multiple tasks – networked ISR, SIGINT, support jamming and other related missions in a dangerous threat environment.'

In this realm, Watters suggested that developments must focus on

multifunction capability specifically for UAS that could be expendable or survivable, ensuring a stand-in capability needed against long-range weapon systems.

He continued: 'In the mid-term, I think you're looking at artificial intelligence and machine learning technologies.'

Whether it is adaptive or cognitive EW, Watters said: 'These technologies will essentially be critical to manned and unmanned teaming in the electromagnetic competition between EW [systems].'

Looking much further into the future, he predicted that quantum technologies will play a significant role in EW systems.

Watters said: 'We're still at the very beginning of developing quantum computing and we're just figuring out how we can utilise quantum concepts for radars and communication systems, but I'm confident that EW needs to leverage quantum technology as well as machine learning in ways that we're just beginning to understand to really become competitive.'

'I think the reason behind that is data becomes so critical and we've got so much data that's feeding into our systems. We've got to be able to determine what data is important to sort [it and] give only required data to the commander to help his decision-making process. [We must also] be able to transmit that data, the required data between systems, very, very rapidly and very accurately,' he commented.

Watters spoke with Helen Haxell



Photo: UK MoD

Swedish training: in the zone

Photo: SAF



STAND ID10

ITEC 2019 in Stockholm will feature a special area dedicated to the Swedish Armed Forces (SAF) where visitors can learn about its structure, organisation and future programmes.

Exercise *Viking*, said an SAF spokesperson, 'is the world's largest

multinational collective training event. It brings together military forces, police and representatives from civilian and humanitarian organisations,' to train in a joint, distributed environment.

'Exercise *Viking* is one of the few exercises that sees civilian and military organisations from 50 nations train together within a NATO architecture and design framework on command and control operations,' said Stefan Sandberg, simulation specialist at GEISTT.

'The Project *Viking* zone will demonstrate how the [SAF] use their

current simulation training aids within a NATO architecture to create joint, virtual exercises. Exercise *Viking* provides a platform to test interoperability techniques being developed by NATO working groups, so being able to engage with the personnel putting these techniques into practice will be a unique opportunity for attendees at ITEC 2019.'

On day two of ITEC, a panel discussion between representatives from the SAF's Exercise *Viking* team will consider: the value of joint exercises; the rationale behind the SAF Combat Simulation Centre's LVC 2025 vision, the importance of being able to utilise gaming technology in a military training environment, and the new SAF-wide strategy on simulation.

By Trevor Nash

CAE offers new Dothan courses

STAND ID35

The CAE Dothan Training Center (DTC) in Alabama is the site for US Army fixed-wing flight training programmes as well as USAF C-12 training. The military-approved and certified training centre is also available to other US and international military customers.

The company has extended its course offering to provide three- and five-day recurrent training on the C-12 (Beech King Air 200) as well as upset recovery training.

The five-day C-12 course is already offered under the US Army's fixed-wing contract but CAE is now extending that to other military operators and some US Army units.

The three-day recurrent course is new and is offered for more experienced C-12/King Air pilots.

By Trevor Nash

New home for Italian Air Force training school

STAND IB35

Leonardo and the Italian Air Force (AMI) will move the International Flight Training School, currently located at Galatina, to a new and dedicated facility at Decimomanu in 2021 in an attempt to bring trainee pilots closer to the action and expand training capabilities.

The facility will include a supersonic area on both sides of the base and students will also have increased exposure to international exercises, explained a Leonardo spokesperson.

The new base will have more than 40 instructors, selected by the AMI, and will be able to train 80 trainees per annum.

The spokesperson also expanded on the company's decision to add four additional M-346 aircraft plus new systems and services in 2019.

The M-346, designated T-346 by the AMI, was added as it is one of the core platforms for the service, 'adding value' to the training school in an

operational environment which was moving 'from dogfights to data fights' and from multi-role to omni-role, according to the company spokesperson.

Among the main features of the T-346 are a modular G selection function, where a pilot's toleration of G-forces can be gradually built up, in addition to its advanced simulation capabilities.

One simulation ability is being able to link simulations with unfolding real-life scenarios where a trainee pilot is able to learn how to fight and exploit a complex mission.

Operational training carried out by the AMI with the T-346A is aimed at preparing pilots to operate the latest-generation combat aircraft including the Eurofighter Typhoon and the F-35 JSF.

Currently the Galatina Air Base is also equipped with LVC training technologies, including advanced CAE-built M-346 full-mission simulators.

By Kate Martyr

US Army introduces new combat fitness test

A US Army Physical Fitness School mobile training team (MTT) has recently returned from Fort Campbell, Kentucky after training 101st Airborne Division (Air Assault) leaders in how to conduct the future service-wide Army Combat Fitness Test (ACFT).

The ACFT is set to replace the current Army Physical Fitness Test that has been the measurement standard since 1980. The new regime includes six events: maximum deadlift; standing power throw; hand-release push-ups; sprint-drag-carry; leg tuck; and a two-mile run.

In essence, the new ACFT is designed to evaluate a broader range of fitness and strength characteristics than previous tests. Many militaries around the world are either looking to embrace new assessments similar to the ACFT or have already done so; the latter group includes the British Army.

The MTT is visiting US Army installations around the world to help soldiers prepare and train for the new fitness standard.

The role of the MTT is to 'train NCOs and junior officers on the ACFT, so they can go back to their units and prepare them once the ACFT is a test of record', explained 1LT Laura Thompson, ACFT MTT officer-in-charge.

First, the MTT personnel briefed commanders and senior leaders from all across Fort Campbell about changes to the test.

Commenting on the ACFT, SSgt Mandy Daniels said that she agrees with the direction the US Army is going with physical fitness.

Daniels commented that the test aims to be a more practical approach to gauge soldiers' strengths and weaknesses in regards to speed, agility, flexibility and overall combat readiness.

By Trevor Nash

Knowing human factors leads to aha moments

Modelling and simulation research has determined that one major challenge facing technological developments in this arena is the relationship between human communication and interaction with technology.

Elaine Raybourn, committee chair at ITEC 2019, explained that whilst this is the case, it is motivating studies into the effectiveness of AI in this field.

She added: 'This is a great time to also be exploring augmented reality and virtual reality. And certainly, the emphasis of what computer games have brought to our industry and... the way we train [have made it] more immersive and more experiential.'

The understanding of human interaction with technology is crucial in ensuring ease of accessibility to deploy equipment on the battlefield, to improve and enhance the experience of the warfighter.

Raybourn told *ITEC Daily News*: 'What we really need to focus on moving forward as a community are the ways that we can connect and interoperate all of our solutions so that we take the onus off of the warfighter.'

'[Taking] the cognitive load off of the individual [means] technologies can really be used to support our cognition, our interactions and all of our human endeavours,' she said.

This convergence between academia, industry and the military assists in the pursuit of these technological solutions for the warfighter, which is further aided by the international collaboration and dialogue achieved at events like ITEC 2019.

'We have speakers from Brazil, Singapore, across Europe and the US. I think it is so beneficial when you're sitting in a presentation and you hear a speaker talk about a solution that really comes out of one's experience in Brazil, for example, that might be completely different from your own experience.'

'And you think, "My goodness, why didn't I think of that?" That's a fantastic solution. And so, there are those "aha" moments that we really try to curate for our delegates with the ITEC programme.'

Interoperable agenda

Furthermore, she shared that another key conference theme on the agenda at ITEC is interoperability, not just of technologies but of personnel too.

Raybourn commented: 'You see the people walking around the show floor, they're looking at technologies and they're really wondering, "How will I be able to use this? How is this going to make the lives of my warfighters better? How will this save lives?"'



Photo: UK MoD



Photo: via Elaine Raybourn

She went on to note that industry must answer these questions through the technologies that are presented.

'At the end of the day we have a very important charter. Our technologies must meet these requirements. These are some really significant challenges that we've always had, but more and more we'll be looking at the ways that we can connect technologies as being one of the greatest challenges.'

Raybourn emphasised that it is not about momentary solutions centred on one issue, but more about the future and how problems and solutions are interlocked between people and technology.

On what to expect from ITEC this week, she explained that the theme is connecting people, technology and countries as well as a focus on disruptive technologies.

'We have a track on human factors and performance in the connected age where we're really looking at that interface of humans and technology and the ways that we can assess progress and learning and performance,' Raybourn said.

She continued: 'We have a track on technologies and architectures,

where we're looking at the different innovative techniques, and infrastructure and architectures that we're currently developing in modelling and simulation. And then finally we have a track on today's challenges and emerging solutions. And in this track, we are looking at new technologies and really looking at the large-scale exercises, the challenges that we face with those.'

New to ITEC this year is DisTec (Disruptive Technology), a track on the show floor with a specific focus on wearables, AR and VR.

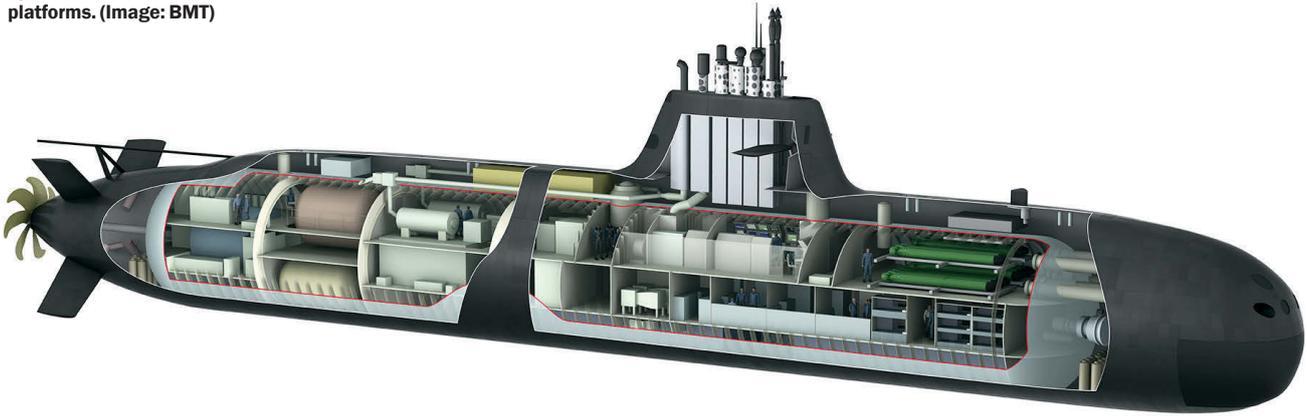
On the bringing together of AOC EW Europe, ITEC and UDT 2019 in one place, Raybourn commented that this one-stop shop for delegates compliments the theme on connecting.

'I think it's great that ITEC is co-located this year with other conferences. I believe too that another benefit will be those "aha" moments that will occur when you take what you're currently thinking about and what matters most to you outside of that particular context and put it in another, you get to see something in a different light.'

By Helen Haxell and Trevor Nash

European endeavours

Since 2017, BMT has since been using the Wyvern design to work out how different technologies could operate on future submarine platforms. (Image: BMT)



At present, many European navies are engaged in the renewal of their fleets, with vessels ranging from high-end combatants to low-end constabulary vessels. This has led to a significant competition between shipbuilders to showcase and market their solutions.

However, one of the most competitive and strategically important sectors of the European naval market is in the provision of new submarines.

Although the two main naval powers in the region, France and the UK, are in the process of modernising their submarine fleets, these are nuclear-powered and therefore mainly a governmental undertaking (in the latter case, this includes procuring the new *Dreadnought*-class nuclear deterrent submarine).

In parallel to this, smaller European navies are taking advantage of conventional submarine technology to procure vessels which, though lacking the speed and endurance of their nuclear-powered counterparts, are becoming more capable all the time.

Many European navies are currently in the process of modernising their fleets, focusing either on conventional submarine technology or nuclear-powered vessels. *UDT Daily News* takes a closer look at established OEMs and new players on the European submarine market bidding for current contracts. **By Jack Richardson**

Projects under way

Two major extant requirements stand out. The first is from the Royal Netherlands Navy with a programme to replace its four aging, yet capable, *Walrus*-class submarines, which date from the 1980s and 1990s.

One competitor is the S80 design currently being built for the Spanish Navy by Navantia. This is marketed as having up to two weeks of underwater endurance by virtue of its fuel cell air-independent propulsion (AIP) system giving it significant expeditionary potential. However, the class has had well-publicised issues with additional compartments being added, resulting in it being unable to fit inside its planned pens.

Another contender for the programme is the A26 design provided by Sweden-based Saab in partnership with Dutch shipbuilder

Damen. This design also features AIP but in the more proven form of the Stirling engine developed by Saab for the Swedish Navy's previous generation of *Gotland*-class submarines.

Saab's design also features a forward mission bay able to deploy unmanned underwater vehicles (UUVs) and/or SF divers. With two examples currently being built for the Swedish Navy, this modular submarine, which uses COTS components to reduce cost, comes in three variants.

The Pelagic version is optimised for littoral waters, whereas the Oceanic and Oceanic (Extended Range) models are intended for blue-water and expeditionary operations.

Also bidding for this contract is German-based Thyssenkrupp Marine Systems (TKMS). This is a company that has many decades of experience constructing SSKs for

the export market from the Type 209, exported extensively in the 1980s, to the more recent Type 214 and Type 218 (the latter will enter service in the next decade with the Republic of Singapore Navy as the *Invincible* class).

TKMS' bid comes off the back of the firm successfully winning the competition to equip the Royal Norwegian Navy with a new generation of submarines, based on the Type 212 (common design) class operated by the German Navy.

The company also has experience in the realm of AIP by fielding a fuel cell developed by German conglomerate Siemens. As part of the agreement, it has been reported that Germany and Norway have agreed to extensive cooperation on the Type 212CD, including the integration of the Interactive Defence and Attack System for Submarines in

addition to the separate purchase of the Naval Strike Missile.

As part of its pitch for the Dutch requirement, TKMS is likely to highlight the economies of scale available through purchasing this type (Italy also operates a similar variant to the current German Type 212A boats).

Established bids

This case will be made as another key regional navy looks to acquire new SSKs. The Polish Navy has received several offers from leading OEMs to replace its Soviet-era submarines. TKMS is also offering a design, likely to be based on the one that Norway is purchasing, opening the door to greater cooperation at a time when these aforementioned nations are in the multirole multinational tanker transport fleet, alongside Belgium and Luxembourg.

While Saab plans to offer Poland the A26 design, France-based Naval Group also has a solution to the requirement, the Scorpène-class SSK, which has been extensively exported around the world to Brazil, Chile, India and Malaysia.

With a wide array of torpedo options and the capability to launch the latest sub-launched version of the Exocet anti-ship missile, this vessel also offers an AIP solution in the form of an ethanol-burning engine. Intriguingly, if selected, France has additionally offered Poland the SCALP cruise missile to give the vessels a land strike capability.

In a statement to *UDT Daily News*, a company spokesperson



In 2018 a common maintenance model for the joint German-Norwegian Type 212CD submarine programme was set up in Norway. (Photo: Shephard picture library)

commented: 'What Naval Group proposes to the Polish Navy is to help it to become [one of] NATO's most powerful conventional submarine fleets.

'Our submarines are a real empowerment tool and will enable Poland to take its rightful place in Europe's defence. With our solution, Poland will acquire a credible military capability that will strengthen its position within NATO and ensure Poland's capability to enforce its sovereignty on the Baltic Sea.'

New players

Whilst these established players vie for the lucrative contracts to supply next-generation submarines, there are signs that other companies are looking to see how they could enter the market.

One example is UK-based design company BMT, which has

marketed various submarine concepts over the years. The latest is the Wyvern SSK concept, which follows the Vidar and SSGT, the latter powered by an innovative hydrogen AIP system.

At this year's UDT, BMT will be showcasing a model of the Wyvern in new configurations. The baseline variant will come in low- and high-risk configurations. With a core crew of 15 and capacity for 21, the low-risk Wyvern is intended to be an affordable solution.

However, with the high-risk model, the company is including a range of innovative features. The key one is powering the design using externally mounted lithium-polymer batteries in order to free up space inside the hull for crew accommodation and mission systems.

The concept originated after the company's previous Vidar concept was disputed by the UK MoD due to the issue of confidential codes. Ian Taylor, senior principle engineer at BMT, said: 'We produced something that is totally exportable, something we can take to many customers and actually anyone can build it, develop it.'

The company is also placing a heavy emphasis on how its design works with UUVs. David Morris, BMT's senior naval architect, commented: 'There's been lots of research on launch and recovery from ships but less from submarines.'

One challenge posed is how a submarine could be fitted with UUV systems during a midlife refit. BMT has worked with Norwegian contractor Hydroid which supplied an example of its REMUS UUV (used for mine countermeasures) adapted to see how it could use whole plug techniques to fit into a submarine mid-life.

Additionally, the company will field a coastguard variant of Wyvern, with the option of fitting a deck gun for use in maritime security operations.

Although at present Wyvern is purely a concept, BMT has made the case that if a customer, shipyard and supporting infrastructure were available, an operational example could be fielded within five years.

This is at a time when there are a large number of existing SSK designs on the market already with established customers. Morris noted: 'With limited budgets, it's all about packing as much capability into a submarine as possible and we wanted to try to flip that and find a design which was affordable, which has a minimum but credible capability that could be built by a nation that was currently relying on other sub nations to construct and supply their submarines.'

The company maintains that it is keeping in touch with key developments in the SSK field, including the examination of various AIP options.



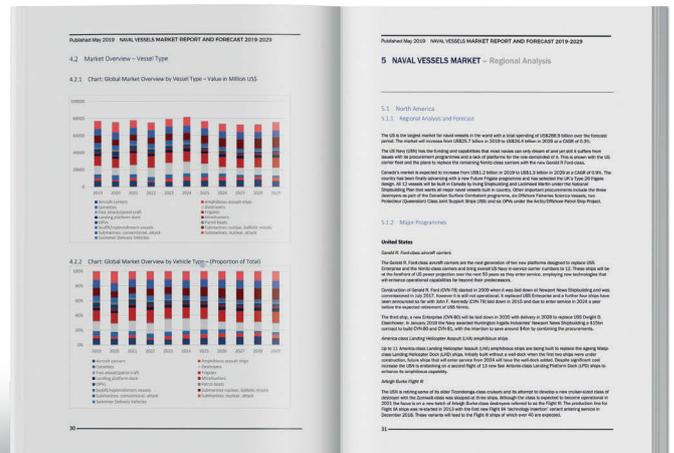
Saab is tasked with both the Gotland upgrade effort as well as the build of future A26 submarines. (Photo: Saab)



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NATO EOD experts are training their Jordanian counterparts in the basics of counter-IED work on a joint course. (Photo: NATO)



NATO's emerging doctrine

NATO is changing the way it thinks about EW, with a new doctrine on the horizon to embrace electromagnetic operations. **By Thomas Withington**

The nuclear physicist Prof Joseph Rotblat once argued that '[the] Cold War is over, but Cold War thinking survives'.

Russia's strengthened strategic posture, as illustrated by Moscow's 2014 annexation of Crimea and involvement in the Ukraine crisis, and continued machinations in the Baltic States and Scandinavia seem to give substance to Rotblat's observation.

Continuing tension

Likewise, NATO is revisiting the 'core business' it practised during the five decades of East-West tension. This is illustrated by the alliance's Enhanced Forward Presence in the Baltic States and Poland and actions by its members such as the routine 'escort' of Russian bombers and reconnaissance aircraft away from UK airspace by the RAF.

'Electronic warfare has always been important in war,' emphasised Cdr Malte von Spreckelsen, chief of the policy section of NATO's Joint Electronic Warfare Core Staff. 'During recent operations, for example in Afghanistan, the electromagnetic [EM] spectrum was not seen as so important, the EW effort was mainly focused on defeating improvised explosive devices [IEDs],' he noted.

In this effort, EW assumed two distinct yet interrelated tasks. The first was to disrupt the means to detonate these IEDs. This usually focused on the jamming of radio frequency signals across a 30MHz-6GHz waveband.

This waveband is typically used by phones and remote-control devices such as garage door openers and even baby monitors. Secondly, EW came into play to monitor insurgent communications.

These often relied on the use of either mobile phones or civilian walkie-talkie-style radios. Communications intelligence-gathering was used to ascertain the insurgent's location and to understand their intentions.

The resurgence of tensions with Russia, and NATO's central role as Europe's security guarantor has again focused minds on ensuring that it can maintain strategic and operational parity with its rival.

'Electronic warfare has to be taken care of as it is more and more important, as technology moves on, and everyone is using the [EM] spectrum,' remarked von Spreckelsen.

He will be presenting a paper entitled 'Electronic Warfare – The Forgotten Discipline' at this year's AOC EW Europe conference and exhibition.

Growing interests

Russia's president Vladimir Putin has presided over a steady increase in the country's defence budget, which languished from the end of the Soviet Union in 1991 until 2007. That year, the budget began to rise from \$31 billion to \$47.7 billion by 2018.

This has translated into procurement of advanced radar systems such as the 92N6E (NATO reporting name *Gravestone*) X-band (8.5GHz to 10.68GHz) ground-based air surveillance radar, which accompanies the Almaz-Antey S-400 (NATO reporting name SA-21 *Growler*) high-altitude surface-to-air missile system and the Tikhomirov NO36 Byelka X-band/L-band (1.215GHz to 1.4GHz) fire control radar equipping Russia's fifth-generation Sukhoi Su-57 fighter.

While one could argue that NATO's understandable preoccupations in Afghanistan have caused the alliance to take its finger off the pulse of EW developments within near-peer



Imagery displaying Russian self-propelled artillery inside Ukraine in 2014.
(Image: DigitalGlobe via NATO)

adversaries, this situation is changing. 'We are living in a lucky time as NATO is [in] the middle of a cycle of review for EW policy and doctrine,' advised von Spreckelsen. 'We reviewed current NATO EW doctrine, and we realised that it is not fit for purpose,' he said.

According to von Spreckelsen, they are 'rewriting the doctrine' as a consequence. This is taking the form of a redrafting of NATO's AJP-3.6B Allied Joint EW Doctrine, which constitutes NATO's 'doctrine for EW at the operational level'.

Drafting the new doctrine, dubbed the Charlie version, is the responsibility of NATO's EW Working Group, which von Spreckelsen chairs. All NATO member states can attend the group, which currently hosts 11 of them that are also involved in writing this doctrine. Von Spreckelsen expects the drafting process to be completed by the end of 2019, with the process having taken two years.

Once this is done, the doctrine will then be sent for approval by NATO's EW Advisory Committee that supervises the development of NATO's EW doctrine, policy and C2 concepts. At that point, the AJP-3.6C doctrine will be ratified and NATO members will then be obliged to ensure that their own EW doctrines meet AJP-3.6C's stipulations.

EM focus

How will the new doctrine differ from its predecessor? While AJP-3.6B is a restricted document,

von Spreckelsen stresses that the Charlie version is designed to be more 'user friendly'. 'We have designed it to be an "EW bible" which the commander can use to support and guide their use of EW at the operational level. One of our key efforts was to write it as a handbook,' he explained.

Content-wise the new doctrine directs its focus towards EM operations as opposed to being strictly confined to EW. Since its first use en masse during World War II, EW has arguably been confined to directing electronic attack, electronic protection and electronic support (the gathering and exploitation of signals intelligence) efforts towards hostile radar and communications systems.

Today, the EM spectrum hosts a mind-bending array of military systems, which depend in some shape of form on this spectrum.

This can include everything from Positioning, Navigation and Timing tools such as Global Navigation Satellite Systems (GNSS), which depend on satellite transmissions in the circa 1.1GHz to 1.6GHz waveband, to cyber operations, which may use existing civilian or military telecommunications as their vector for attack. Even space operations, which rely on satellite and spacecraft telemetry, inhabit the EM spectrum.

As such, NATO now perceives these disparate efforts in a more holistic fashion, which makes sense. Recent Russian operations in Ukraine and Syria witnessed

traditional EW in the form of jamming directed against hostile communications, but also witnessed attacks against GNSS.

New rules, new tools

'Above Us Only Stars', a recent report published by the C4ADS think tank based in Washington DC, leaves no doubt as to the breadth of Russian GNSS jamming efforts. Similarly, the Russian armed forces have become adept at psychological operations. Anecdotal evidence from the Ukraine theatre mentions Ukrainian troops receiving misleading or demoralising messages on their mobile phones believed to originate from Russian sources.

All these examples illustrate a Russian preponderance for using the EM spectrum as the vector through which a particular effect can be delivered. It makes sense for NATO to match, and preferably surpass, its rival's thinking to ensure that it can enjoy freedom of manoeuvre in the EM space.

'Today we are talking about spectrum operations. We have to be able to operate in the electromagnetic spectrum,' emphasised von Spreckelsen, adding that they 'want to move away from just EW'.

He believes that this is becoming increasingly apparent at the operational and tactical levels. Across the air, land and sea domains a commander would have performed EW, which would have principally focused on the destruction, deception and degradation of their adversary's communications and radar capabilities.

Today, EM operations will assume increasing importance on the battlefield. 'You have to consider spectrum

management, space and cyber for instance, as they all depend upon the electromagnetic spectrum,' he said. For example, an adversary's battle management systems will be as dependent on telecommunications as the soldier giving a verbal situation report from the foxhole.

Nonetheless, it is important to ensure that this is understood throughout NATO. Spreading the word is as important as spreading the doctrine. 'The EW community understands this very well. They see the spectrum as a warfighting domain. People are starting to listen on the military side once again, although this can be a slow but steady process,' von Spreckelsen noted.

'History may not repeat itself, but it does rhyme' is a quote attributed to the author Mark Twain. While it is tempting to see parallels in paradigms vis-à-vis NATO's tempestuous relationship with Russia, there are subtle differences. This is arguably nowhere better illustrated than in Russia's military use of the EM spectrum. Fortunately, as the drafting of AJP-3.6C has shown, the alliance will soon have new tools for these new rules.

NATO troops taught Jordanian students how to properly find and neutralise IEDs while collecting the evidence necessary to stop the bombers.
(Photo: NATO)



A USAF pilot trainee tries out a variety of technologies which include virtual and augmented reality, advanced biometrics, AI and data analytics. (Photo: US DoD)



Whether AI? Whither AI?

ITEC Daily News puts AI under the microscope to give an overview of the status quo of this contested concept. From the training world to news channels, AI is attracting attention and dividing opinions because of the enormous capability that it brings. **By Miles Quartermain**

On the one hand, wander the corridors of ITEC and listen to the conversations on and off the booths and one gets the overriding impression that the training world is fully embracing AI and all it can do for us.

On the other hand, pick up a newspaper or turn on a broadcast news channel and one could quickly begin to believe AI is already here and is about to subtly but irreversibly enslave the human race.

Like so many of the issues worthy of debate in simulation and training, the truth lies somewhere between these poles. But what, precisely, is the state of play with regard to AI? And where is it most likely headed?

Immense potential

Clearly, AI has progressed in recent years. One of the issues in assessing its impact, however, is the opacity created by the lack of agreement in precisely defining what AI is.

While opinions differ, it can be asserted that an adequate definition includes the element that sets it apart from what the RAND Corporation now calls 'frozen software' (ie software that has no capacity for self-improvement). That element is the capacity to learn and, by learning, alter its behaviour and approach to problem-solving.

From a military training perspective, that is an exciting and potentially immensely valuable capability. Take the pinnacle of the current training pyramid (or at least, the domain in which more visible money is spent than any other single sector) – fighter pilot training. The capability that AI could potentially bring to this domain – to generate agile, unpredictable and credible adversaries in a synthetic environment – could have ramifications that affect everything from training syllabus structure through equipment capitalisation to contracted training solutions.

After all, the argument might run, if we can depend on consistent performance from AI-generated adversaries, do we need expensive contracted 'Red Air' services?

Since the increasing importance of those services is a subject of great current interest, it is worth considering seriously the prospect that an AI construct could provide a similarly or even more effective solution without the cost of infrastructure and support that characterises current contracted services.

The adversarial air domain also brings into clear perspective the single issue that clouds the AI event horizon more than any other – the human dimension. It is human beings we seek to train. We seek to train them in the use of equipment and the 'correct' tactical procedures to follow in a predetermined set of circumstances.

We also seek, however, to improve their decision-making

skills, their intuitive grasp of 'the right thing to do' and their ability to take multiple intangible factors into account in making those decisions and arriving at those actions.

To do that requires not merely the ability to do countless thousands of things at extreme speed and to process almost unimaginable volumes of data quickly and efficiently – it requires the trainee to marshal facts and draw conclusions from disparate sensory inputs in nanoseconds.

This ability is what the backroom boffins have sought for decades – it is what gives hope to those who believe AI is a force for good and fuels the insecurities of those who believe the *I, Robot* nightmare is just around the corner.

Training bias

The extent to which the 'ideal' training solution (if there is, indeed, such a beast) depends on the careful balancing of live, virtual and constructive elements has been debated at ITEC and elsewhere almost ad nauseam.

It is interesting, though, that even an executive who one might assume to be firmly wedded to the supremacy of the synthetic environment, Arthur Alexion, CEO of Bohemia Interactive



Using AI for computer-generated forces adds a major layer of complexity and realism to the training scenario. (Image: Rockwell Collins)

Simulations, recently commented that, given free preference, the vast majority of training deliverers would prefer to use live training wherever possible.

There are many reasons for that, but one rarely discussed is the fact that the live environment not only induces many of the stresses – mental and physical – that the parallel operational environment would, but also forces the trainee – instinctively and intuitively – to work in an entirely different manner to that which he or she adopts in the simulator.

There is a bias towards live training and that bias may be as difficult to alter as was the successful encouragement of the ‘willing suspension of disbelief’ in the early days of simulator-based training. This is the area in which AI can excel, proponents believe.

Lest the reader believes our entire thesis is based solely on the esoteric world of fast-jet training, consider the requirements to provide a frigate captain with an environment in which to react successfully to the unpredictable behaviour of swarms of fast-moving missile-armed boats in shallow waters, or a brigade commander having to confront hundreds of unmanned ground and aerial systems in a massively congested and contested battlespace in which jamming has deprived his force of much of the advanced capabilities it boasted in the simulator.

In both those cases, the capacity for successfully instilling ‘correct’ behaviour will be made

infinitely easier if the training medium is agile, flexible and powerful enough to stress the individual to the limit while intelligently leaving sufficient freedom of action to ensure that the complexity of the situation does not simply overwhelm or cause decision paralysis. AI may well be a viable option worthy of consideration here.

Dispelling doubts

The potential benefits of AI are reasonably clear. So where has it got to? Until now, the majority of so-called AI solutions have been rule-based software sets that, though flexible and agile, lack the

learning capabilities that define ‘true’ AI.

Useful and effective as they have been – from both operational and developmental perspectives – their time may, to a large extent, be approaching its end. If, that is, AI is ready to take that next step forward: a supposition for which the evidence is more than a little mixed.

Boeing is in the news at the moment for having allegedly developed and installed a device in the 737 Max that would take over from the pilot in the event the computer decided the aircraft was approaching a potentially fatal stall.

There is considerable evidence to suggest that, in at least two cases, the existence of this capability, coupled with the fact that apparently no training had been given in how to countermand the computer-instigated flight profile, contributed to two fatal crashes within five months.

The importance of this lies not in the fact that the system was

nascent AI – it was not – but in the fact that accidents like this fuel the fears of the less well-informed public that computer-generated decision-making is dangerous and intrinsically inimical.

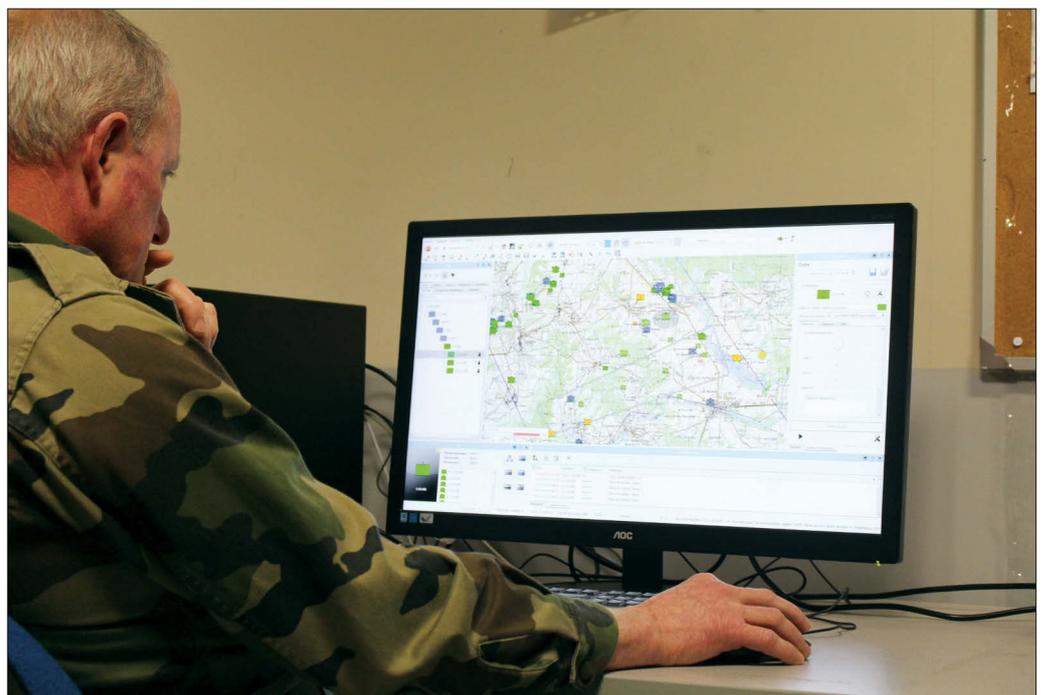
Deep Mind, an AI firm, has been researching the ability of AI constructs to learn relatively simple mathematics from a zero starting point and has encountered some intriguing – not to say inexplicable – issues.

Faced with a powerful AI failing to score above 35% in a maths exam taken by 14-year-old school children in Britain, researchers are unable to explain why the construct correctly calculates that $1+1+1+1+1+1 = 6$, but fails to answer correctly when a further 1 is added, for example.

AI is here, is alive and well and is gradually being better understood – that much is certain. That it can potentially be immensely useful to complex areas of behavioural training, and doing so in an effective and affordable manner, is equally certain.

However, there is a way to go before trust in its abilities begins to approach the universal, but that does not mean we should not endeavour to further develop and perfect it.

MASA's SWORD command and staff constructive training system has used AI for a number of years. (Photo: Trevor Nash)



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