

ITEC continues to progress diverse industry solutions

Photo: Clarion Events



Celebrating its 30th year, ITEC is Europe's premier training, simulation and education event that draws participants from across the region and beyond. As well as the extensive speaker programme and exhibition hall, ITEC provides the opportunity for delegates to discuss common issues and share solutions.

A further testament to the success of the event is the more than 40% new exhibitors displaying their wares, including Air Target Sweden, ÅF Digital Solutions and BMT.

'ITEC is a unique show and I encourage you to take advantage of the diverse expertise of your ITEC colleagues in the plenary panels, sessions, exhibition and while networking,' said Dr Elaine Raybourn, ITEC 2019 committee chair and principal technical staff lead for applied cognitive science at Sandia National Laboratories, on the opening day.

The diversity of expertise highlighted by Raybourn was apparent in the opening keynote panel. MG Karl Engelbrektson, Chief of the Swedish Army, discussed the training challenges facing the service, whilst Hans Lindgren, head of business development at Saab Training, considered how common standards can enable joint training to take place.

'Common standards can only enhance and encourage more joint training to improve readiness and coalition unity,' said Lindgren.

Along with MG Engelbrektson's keynote, the national presence was magnified in the Swedish

Armed Forces Zone that gave visitors the opportunity to learn more about military operations and requirements, particularly Exercise Viking.

In total, a quarter of companies in attendance are Swedish and 30% of exhibitors are from the Scandinavian region, with a total of 21 different countries showing their products to attendees.

'We have a number of first-time exhibitors attending this year, along with many returning primes, and as the event is taking place in Stockholm, exhibitors will have the opportunity to showcase their solutions to international partners and top-tier decision-makers in the Swedish Armed Forces,' Tracy Bebbington, event director at Clarion Defence and Security said.

The main conference themes are focussing on human factors and performance in a connected age, technologies and architectures and today's challenges, tomorrow's needs, emerging solutions.

She added: 'ITEC offers a unique perspective on the key issues facing the European military, civil defence and security community as it looks to the coming decade and the challenges that it will bring. We know that integrated solutions, that advance interoperability at every level, will be key to solving these challenges, and ITEC is the best place for players in this market to meet, collaborate and share ideas.'

Next year's event will be held at ExCeL London, from 28-30 April.

By Trevor Nash and Helen Haxell

DAY THREE

15 May 2019

Inside this issue:

Low cost, high output

Page 9

Modern synthetic training equipment is drastically reducing the time new pilots spend in the real aircraft.

A head for depths

Page 11

Safety, visibility and mission endurance are among the challenges being tackled by suppliers of military diving equipment.

E for electronic?

Page 13

Modern fast jets, exemplified by Saab's Gripen-E, are increasingly potent EW platforms.

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MTSN
MILITARY TRAINING & SIMULATION NEWS

 **SHEPHARD**

Germany closes Tornado gap

STAND ID35

The German Air Force (GAF) and navy was one of the largest customers for the Panavia Tornado aircraft and although the latter has disposed of its maritime strike variant, the GAF still has two wings operating the aircraft.

The two units are based at Büchel and Schleswig/Jagel, and both units are expected to remain in the order of battle until 2030, although as there is no replacement for the long-serving aircraft on the horizon as Germany eschewed participation in the F-35 JSF project, many pundits are predicting an out-of-service date of 2035.

The current simulators for the type, one each at Jagel and Büchel, and another in transit from Holloman AFB in New Mexico that was used by the former GAF training unit that operated from the US, were originally built in 1983.

These dome-based devices have been upgraded over the intervening years but they suffer from serious obsolescence issues and do not

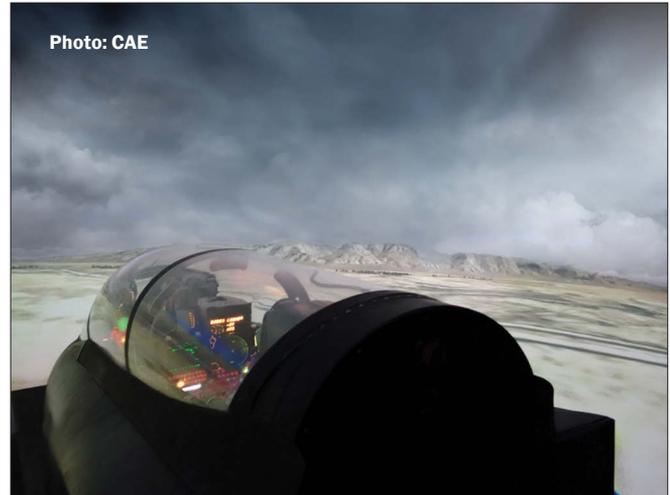
match the GAF's 21st-century training requirements.

The most recent upgrade has seen the addition of Zeiss Velvet 1600 projectors. These, somewhat belatedly, are now being upgraded with an NVG capability. This is a rather surprising omission considering the GAF has been without this capability for a number of years.

The air force has a Tornado Roadmap plan to resolve concurrency issues; this has been developed in conjunction with the simulator manufacturer and support organisation, CAE GmbH.

In essence, this roadmap is designed to: solve obsolescence issues; reach and maintain aircraft concurrency; enable and achieve networking capability; improve cyber security compliance; and act as a driver for the PASE (Platform Agnostic Synthetic Environment) to enable networking with the GAF's Eurofighter Typhoon training devices.

This enhancement plan is an ambitious one, especially considering the glacial state of the German



military procurement process and the country's inability to fund long-term projects. For example, the returning simulator from Holloman AFB that is destined for Jagel does not have a dedicated building ready for it and therefore will be located in an 'interim facility'.

That said, a number of key projects are under way, not least of which is a new instructor operating station (IOS) that is being developed by CAE at its headquarters in Stolberg,

Germany. The IOS project is being assisted by three former Tornado simulators at Stolberg and the first system will be delivered to Büchel in 2020.

This will be followed by a new laser designator simulation capability that is expected to be available for training in 2021.

Slowly but surely, the German Air Force Tornado training capability gap is being closed.

By Trevor Nash

TrianGraphics spreads its 3D wings



STAND ID60

Epic Games has added another string to its bow with database specialists TrianGraphics now offering export of its Trian3DBuilder straight into the game engine, Unreal Engine.

The Trian3DBuilder capability follows other exported databases

from amongst others, ESRI, Presagis and Open Street Map.

'We are extremely pleased with this new capability provided by TrianGraphics,' said Sebastien Loze, manager, industries and simulations at Epic Games, 'as it offers developers new opportunities.'

Epic Games' business is divided into two main streams: the

publishing side of the business focuses on video games, primarily the collaborative game, Fortnite, that currently has around 250 million subscribers. The second stream, software, comprises games and enterprise and it is the latter that makes up most of the military training applications side.

'Through Unreal Engine we are providing a tool to develop simulations much faster than was possible a few years ago,' explained Loze. 'Unreal Engine is free and people only pay for support and training.'

'In B2B applications there are also no royalties to be paid for the result of development projects.'

The uptake of Unreal Engine has been significant in recent years. Customers include Cubic Global Defense, which developed simulators for the Littoral Combat

Ship and UAS; Boeing for a part-task trainer; and Northrop Grumman for a naval engine room simulator, as well as smaller developers creating healthcare simulations.

'One of our real benefits is that Unreal Engine is HLA/DIS compliant,' said Loze, 'although this does require a free plug-in from coreDS.'

The Unreal Engine is a relatively new player in the military simulation market. In the enterprise side of the business, the system was used for architectural design before being used in film and TV and subsequently, manufacture and design.

'It was therefore a mature product before entering the training and simulation market,' said Loze. 'We are very excited about its future as it is drawing increasing amounts of interest from developers.'

By Trevor Nash

MASA's Sword gives cutting edge to HADR training

STAND IA40

As a long-term user of MASA's Sword computer-based constructive training system, the Bangladesh Army has been instrumental in developing the product over the past three years.

As well as its normal warfighting roles, the army is heavily involved in providing support to the civil authorities, something particularly relevant in a country that is prone to floods, cyclones and earthquakes.

As part of the preparations to deal with such events, the Bangladesh Army led a week-long earthquake relief exercise, involving 24 organisations. This was held at the Army War Game Center (AWGC), where Sword played a key role in simulating police, army, medical and local government organisations.

The exercise was designed to: identify shortfalls in disaster response and planning strategies;

develop robust response procedures; develop cohesive teamwork strategies; and highlight areas for improvement in the future.

The Bangladesh Army has built a strong reputation when it comes to disaster relief, not only in its own country but as part of UN missions around the world. The army has topped the league as the leading troop contributor, providing around 120,000 personnel over 28 years.

Planning for the exercise began in July 2018 when MASA personnel began to work with the army to create relevant scenarios for predicted natural disasters. For its part, the army liaised with participating organisations to ensure up-to-date data, equipment tables, organisational structures and mapping were integrated with Sword.

The AI-based Sword was also modified to add elements to facilitate the exercise. As well as

using it for its normal command and staff training role, a number of Sword customers have conducted similar scenarios, including France and Brazil.

During the week-long exercise, MASA staff were available to provide technical support. The after-action review ensured that lessons learned were understood by all those who participated.

'Bangladesh sits in a very sensitive spot geographically and is exposed to a range of weather-related natural disasters,' explained BG Md Tofayel Ahmed, director of the AWGC.

'We are particularly concerned about how the country would deal with a large earthquake. We needed to learn how all the different agencies could work together effectively should this occur, and what likely difficulties and obstacles we might face. Using Sword, we were able to identify the risks and begin

to work together as a larger team to overcome what would be a country-wide disaster.'

MASA has also announced that the partnership with AWGC will continue following renewal of its Sword licensing agreement with the Bangladesh Army for a further five years.

In other MASA news, the company maintains support for an undisclosed customer in Japan that is trialling its system, whilst in France, Sword continues deployment to enable troops to conduct regimental training functions as part of Project SOULT.

Further afield, the establishment of MASA's Brazilian subsidiary is now complete with this organisation aimed at supporting Sword systems that are in service with the Brazilian Army and acting as a springboard for customers in South America as a whole.

By Trevor Nash

Virtual Training For Any Weapon

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BAE pushes Type 26 for ASW

STAND B11

Twelve months after Australia announced its selection of the BAE Systems Type 26 Global Combat Ship, the company can now boast a total order book of more than 30 with Canada and the UK's Royal Navy (RN) making up the user community.

BAE Systems once again showcased a model of the anti-submarine warfare (ASW) ship at UDT. Speaking to *UDT Daily News*, Josh Goodwin, business development manager, BAE Systems Naval Ships, said that the company was continuing to promote the platform to other nations that might be interested, however it was too early to mention any names.

He noted that of course the Type 26 is a high-end platform which would be relevant to a limited number of nations, but confirmed that there were 'strong sniffs' coming from other potential customers.

'It is a manifestation of a trend to reinvest in ASW capabilities,' Goodwin said.

One thing that might appeal to potential future customers is the fact that a Type 26 user community group has already been set up and meets roughly every six months.

Things are now in full swing regarding the Australian contract for nine Future Frigates, and BAE Systems said that Australian company ASC Shipbuilding will fall fully under BAE Systems Australia for the duration of the contract and will build the vessels at the Osborne Naval Shipyard.

Engineers are now being sent to Australia for an education programme on the combat system and likewise there are Australian team members in Glasgow learning about shipbuilding and design as the Royal Navy's HMS *Glasgow* continues its build.

The Australian contract is said to be worth \$25.8 billion.



Photo: author

In the UK all eight of the vessels that make up the City class have now been named by the RN.

Work on the £1.2 billion warship has been under way since mid-July 2017 and the first in class is being constructed in two sections; first the forward part, followed by the stern. The two will be joined on the slipway outside the shed and the main mast and bridge section will be lifted into place.

Meanwhile, Canada was the most recent nation to join the Type 26 club as part of its

Canadian Surface Combatant (CSC) programme.

As with the Australian and UK programmes, the amount of domestic input will be key in ensuring that the vessels are seen as both a military and industrial success story. Irving Shipbuilding will build all 15 ships at its Halifax Shipyard.

For Canada, a design phase will run for about three years before steel is cut, which is currently likely to occur between 2021-2024. The initial design contract is valued at \$139.5 million.

By Beth Maundrill

EmbeddedArt displays multi-use mini-sub



Photo: author

STAND A40

First-time exhibitor EmbeddedArt showcased its 10,000kg mini-sub UVS 1300 Malen to visitors at UDT. The fully functional vessel is available to hire for training, sea trials and research projects.

Speaking to *UDT Daily News*, Matti Kaikkonen, sales director at

EmbeddedArt, said that the company acquired the mini-sub in autumn 2018 and will have it fully operational at sea in six months' time. 'The intention is to provide [it to] Swedish defence to use as a training target for ASW or as a sensor platform for research,' Kaikkonen explained.

The company has self-funded the development of the mini-sub and

Kaikkonen said it was the first time the Stockholm-based company had embarked on such a project. He added that while the work had been initially for Swedish defence, there was interest in the project from a number of other nations.

Work continues on the USV 1300 and Kaikkonen noted that 'we will have to decide what kind of sonar systems we have on board and what navigation'.

The company presents itself as an underwater systems specialist and works closely with the Swedish military on research and development projects.

The submarine is 10m in length, 1.4m in width and has an operating depth of 60m, which suits it to the Baltic Sea which has an average depth of up to 65m. It is set to open

up new areas of participation for EmbeddedArt.

The company claims long experience working with mining, sonar, sensor, data collection and measurement systems.

EmbeddedArt also carries out preventative and remedial maintenance of systems, with work carried out at either commercial shipyards, such as SRV, Ö-varvet, Hasslö Varv and others, or in the company's own workshop.

During UDT 2019 the company also displayed a sonobouy system and various diving equipment. EmbeddedArt also provides commercial diving supplies, including video, lighting and voice communications as well as breathing systems, control panels and container systems.

By Beth Maundrill

UK 'SubClub' targets export opportunities

Whilst the UK might not build non-SSN submarines directly (or export them), the British government has turned its focus onto the domestic companies, across the supply chain, that manufacture vital components and systems that provide the DNA for these machines.

The UK's Defence & Security Organisation (DSO) coordinates a collaboration with more than 40 businesses that meet a few times a year to share knowledge, market information and details on prospective opportunities from around the world in the naval and maritime field.

Cdre Stephen Walker, senior military adviser – submarine capability lead at DSO, told *UDT Daily News* that the grouping of British businesses were here to present the UK market, 'representing a holistic ecosystem of submarine/maritime capabilities'.

Referencing just some of the British companies present, he said how the 43 members of the so-called SubClub 'represent a realistic picture of the UK in a dynamic export market'.

The genesis of the SubClub began in earnest five years ago, he said, explaining that since then it has gradually developed into a collective which comes together under the umbrella of DSO 'to discuss the submarine export market and the opportunities available'.

Within his role as submarine capability lead at DSO, Walker acts as the secretary and chair for the SubClub and is able to present the government perspective on UK policies and market opportunities.

The forum enables industry, without infringing on commercially sensitive matters, to information-share on the prospects that present themselves.

Walker continued that this was an embodiment of the UK helping itself by identifying potential growth areas. Furthermore, if an international customer has a supply problem or industrial challenge and needs a specific technological solution, UK business can put thought towards how it can solve the challenge.

'[SubClub] is a loose consortium to develop a customer solution under a government umbrella. DSO can do the government-to-government [work] for the consortium,' he commented.

Adding on what the UK can bring to the international submarine market, Walker noted: 'We do not export submarines in the UK, we do not have a prime contractor [per se] like the major foreign submarine developers. We do not build submarines domestically.'

'However, we build engines, non-nuclear, we make batteries and combat systems [for submarine platforms]. So, the SubClub exposes this supply chain.'



Photo: Beth Maundrill

Some of the companies participating in SubClub include: Atebtech, Chelsea Technology, Frazer-Nash and the TP Group.

'UDT is one of the best of the trade shows. It's specific with a strong targeted conference with a substantial trade show,' Walker stated.

He added further that what he would be seeking from the show is to 'try and expand the UK stand to represent the full UK ecosystem of submarine capabilities'.

One member of the SubClub is the Westley Group (above). Based in the West Midlands of the UK, the engineering company manufactures high-safety castings and forgings for a variety of challenging environments.

'We provide... castings which are used in subsystems that go onto nuclear-powered and conventional submarines,' said Nick Cooper, sales director at Westley. On the company's placement in the

submarine supply chain, Cooper said: 'We are at the start of things, you need castings to assemble these products.'

With in-house machining and assembly of high-integrity castings of all sizes, the group has full control over the manufacture and supply of components and provides finished machined assemblies to naval industries, and others, around the world.

Cooper said that with companies like the Westley Group at the beginning of the process, its timeliness and quality of product is integral to wider programme support.

'In any programme, the success [is dependent] on producing components at the right quality and the right time. The more support we get from customers, government and the MoD the more likely it is to de-risk the programme.'

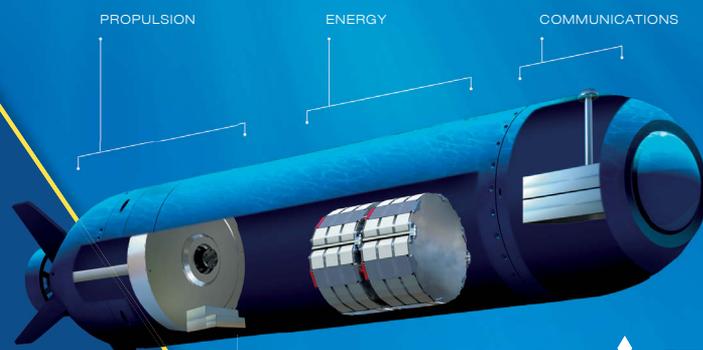
By Helen Haxell

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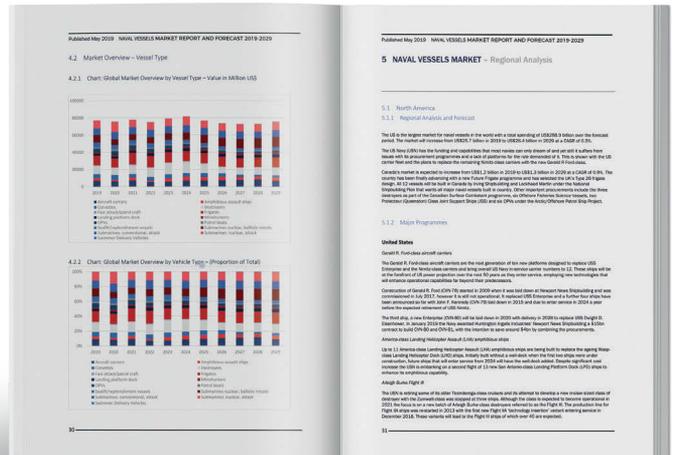
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Kirintec, Metis display EW prowess

STAND A3

The Mercury Blade 5 (right) from Kirintec is the latest version of the company's vehicle platform for jamming systems, and by the end of 2019 the portfolio of Blade vehicle-mounted systems is set to have around 1,000 units in service globally.

On display at AOC EW Europe, the system was first fielded in 2014 and has now evolved to version 5, James Baker, sales director at Kirintec, told *AOC EW Daily News*.

Bolstering the number of units in operation has been aided by the system's capability to change modules down the line as RF evolves.

It can be utilised on the battlefield as well as for VIP protection operations. 'One customer has [upgraded] from the Blade 4 to 5,' Baker shared.

The Blade 5 is fully programmable with each module enabling a jamming capability honed in to a specific part of the RF spectrum. With 500W of power, it has a frequency range of 20MHz to 6GHz. Further functionalities include: a built-in self-

test, anti-tamper features, zero-ising and a remote-control unit.

Ten years old, Kirintec is a UK company that specialises in the EW area, amongst other sectors, but at the show the focus is on IED and counter-UAS jammers, which are all fielded and mission-proven.

'With the Blade [nearing] on 1,000 systems around the world and the Ventura in the hundreds [of units], we are taking on bigger programmes... we have Tier 1 NATO and special operation forces customers,' Baker commented.

The above-mentioned Mercury Ventura comprises of a manpack and dock. The former is a high-power man-portable carry-forward system with detachable battery cage. When the optional vehicle docking station is combined with the manpack, it enables deployment as a vehicle-mounted system.

'It can be a tailored mission system for threats', Baker commented. The interface for the system is simple and graphical, Baker noted, further explaining that this ensured easier training for operators.



Photo: author

Kirintec is sharing its stand with a collaborative partner, Metis Aerospace, which it has been working with for around 18 months.

Metis CEO Tony Burrell commented to *AOC EW Europe Daily News*: 'Our systems provide signal intelligence solutions to the commercial and military market.'

Burrell, former military personnel, founded the company in 2012 focusing on airborne SIGINT technologies which were developed from an operator's perspective.

Four years later, the company's proof of concept was revealed in the shape of Hyperion. It is a COMINT

system that can function separately or as a network node, delivering spectrum awareness and analysis. It allows highly accurate signal detection, geolocation and tracking of RF signals of interest.

Its other product is Skyperion – a drone detection system, which Burrell says has the same architecture but different software to Hyperion. It has been fitted to a commercial drone which has participated in UK MoD trials in light of the recent Gatwick Airport incident involving UAV activity. He shared that it was now part of a permanent installation at Gatwick.

By Helen Haxell

Kalaetron radar warner makes show debut



Photo: author

STAND A12

Munich-based company Hensoldt revealed its new radar warning system for aircraft and helicopters, known as Kalaetron, for the first time at AOC EW Europe 2019 in Stockholm.

The Kalaetron radar warning receiver (RWR) is designed to

protect aircraft from radar-guided weapons.

The RWS has a fully digital design and is able to detect and identify threats quickly. It also has a very low false alarm rate over a wide frequency range.

Speaking to *AOC EW Europe Daily News* a company official said that the RWR is a modular design

specifically for EMS and ELINT applications. The Kalaetron can be used with numerous antennas.

The company began software development of the RWR in 2015 and hardware development in 2016, with the product now ready for the market.

It is likely that the first operator will be Germany as the company official confirmed that Hensoldt had been working closely with the domestic customer. Flight tests were carried out in 2017, and future testing is planned for 2019.

The upcoming tests will be on an in-service German platform, according to the company official, as the customer wants to test the Kalaetron performance in an operational scenario.

Hensoldt also suggests that the Kalaetron can be a solution as part

of both upgrade programmes and new acquisitions involving a radar warner.

The Kalaetron RWR uses artificial intelligence techniques to detect new threat patterns from a vast amount of collected raw data. This is especially important to identify the latest air defence radar systems that cover an extremely wide bandwidth, or which hop between particular frequencies in fractions of a second, according to the company.

The RWR looks to solve some of the problems that existing systems have, which the company identifies as objects being classified and located too slowly, susceptibility to countermeasures, high false alarm rates and the partial lack of ways to record events from the previous mission.

By Beth Maundrill

Conference highlights 'serious' Russian threat

AOC EW Europe 2019 highlighted the need for a continuing focus on the EW domain, as the conference warned that one of NATO's primary adversary, Russia, is serious, equipped and prepared for EW.

The word complacency was not used, but the rhetoric highlighted the fact that 'we', namely NATO nations and their allies, have lost the EW advantage that was once held some decades ago.

At this time there is a need to improve on commonality of approach between nations, regarding both mission planning systems and C2. There was a call to attendees to consider how 'we' train as a multi-national group in the EW sphere.

There was also an emphasis on the speed at which EW is developed. Going forward, there is a need for a focus on artificial intelligence and networks between sensors, as well as looking at big data.

Sweden itself puts a clear focus on EW with multiple test sites across the country carrying out ongoing EW testing with the MoD's Defence Materiel Association (FMV).

The Scandinavian nation also takes part in the Surface-to-Air Launch Trials (SALT) which test missile approach warning systems. The trials have explored directional IR countermeasures and active jamming systems.

One of the test sites, in the far north of the country, is equipped as a missile firing range and has been used for live EW and GPS jamming tests as well trials of mobile EW systems.

Härnösand and Karlskrona are both test sites that focus on naval capabilities, while Linköping is used for flight testing; all have EW testing ongoing. In particular, Linköping oversees development of the Gripen-C/D and E aircraft and with OEM Saab the FMV is continuing to test and



evaluate the EW capabilities of the fighter jet (see p13).

The FMV has used a Sabreliner aircraft with an airborne stand-off radar to further the development of the Gripen-E. The solution is currently being tested.

While there is a resurgent adversary in the EW domain, this area is certainly not being neglected, AOC EW Europe 2019, the 24th iteration of the exhibition, grew in size with 45 nations present and 80

sponsors and exhibitors. The conference and exhibition is supported by the Association of Old Crows (AOC), which supports 67 chapters across 20 countries, with two more nations potentially being added to the list in 2019. The event in Stockholm was supported by volunteers from the Viking Roost chapter of the AOC based in Sweden. This chapter is set to celebrate its 30th anniversary in 2019.

By Beth Maundrill

Radio DF solution showcased by IZT



STAND C7

Germany-based IZT is introducing its new R5506 Radio Direction Finder (RDF) for the first time at AOC EW Europe 2019 in Stockholm.

The new RDF is a compact, high-performance solution covering

a frequency range of 1-6,000MHz with 60MHz instantaneous bandwidth. The RF and digital processing is closely integrated with the antenna system and involves a five-channel receiver.

The company showcased the R5506 integrated into an antenna from South African company Alaris.

The decision to use this antenna was taken because 'it is hard to find independent antenna providers,' according to Rainer Perthold, general manager at IZT.

Perthold noted that in this case the RDF had been integrated inside of the antenna, because there was room to do so, but it could also, and typically would be, attached externally.

The company focuses on high-performance RF technologies in communications, according to Perthold, so the addition of the R5506 was a 'logical extension to our product portfolio'.

Other features include the receiver being non-switching, which should maximise sensitivity and minimise detection times. It samples signals synchronously from all antenna elements in a

specific frequency band, thereby eliminating the need for additional RF switches. Company literature states that, if supported by the DF processor software, this feature allows short detection times, beamforming and maximum sensitivity.

In addition, the receiver uses only a hybrid cable to the indoor unit and processor which means the system is quick to install and can be utilised at a significant distance away from the processor, increasing operational flexibility. It also avoids loss of performance due to long coaxial cables.

The indoor unit for the IZT R5506 contains the power supply, surge protection and access to the DF processor server. All of the sensor's functions are remote controlled via the optical interface.

By Beth Maundrill



CAE's Rise is designed to allow instructors to deliver standardised lessons. (Photo: CAE)

Low cost, high output

The historical approach to military training has always been a linear one whereby the student's experience and knowledge levels have been expanded before they move on to the next level of synthetic training equipment (STE).

Typically, and especially in the case of the military pilot, this training would start in the classroom using cognitive behavioural therapy, move up the STE feed chain to utilise part-task trainers (PTT) that had the form, fit and function of the real platform, and then complete training on the full mission simulator (FMS), the ultimate in platform replication in terms of fidelity.

New norm

It is only relatively recently that the FMS phase has increased significantly at the expense of time flying the actual platform. What is now considered as the norm sees student pilots alternate STE and live training with the former providing the

main learning environment and the latter acting as a validation process for the lessons learned in the simulator. **Innovative new technologies have brought about changing approaches to military pilot training, with the role of synthetic training equipment increasing compared to time flying the actual platform. By Trevor Nash**

main learning environment and the latter acting as a validation process for the lessons learned in the simulator.

When considering the PTT, and especially the FMS, received wisdom dictated that form, fit and function were everything. These were vital, some argued and indeed still do, to prevent negative training whereby students accreted wrong procedures to achieve a desired outcome on the simulator.

A crude example might be that on the real platform, landing gear might be lowered and raised by a lever, but in the STE that lever might be replicated by a virtual switch that is itself triggered by a haptic feedback glove.

This is nothing like the real thing, but is it sufficient? The fact is that few people can provide a concrete

answer. Those in favour of accurate replication would argue that form, fit and function must be exactly the same as the aircraft to provide spatial awareness and develop muscle memory so that tasks can be completed rapidly and efficiently, especially in a pressurised or emergency situation, without having to think too much about where items are situated or how they feel.

Tech focused

If the industry and user community ditch the tried-and-tested methods, are we in danger of throwing out the baby – innovative new technologies – with the bath water that represents stable and proven training methodologies?

However, changes to the linear training status quo are afoot. A

number of companies – notably CAE, FlightSafety International, L3 Link Training & Simulation, Lockheed Martin and TRU Simulation + Training – have been discussing and demonstrating what can best be described as low-cost, medium-fidelity, small-footprint training devices.

On this, TRU provides a perspective on the emerging trend as it affects helicopter training. 'While we see a place for the traditional high-fidelity simulators in the military rotary-wing market, we also see the addition of some new technology to help provide more hands-on opportunities for students to learn at their own pace,' said John Hayward, senior VP and general manager of TRU's government division.



L3 Link Training & Simulation launched its BBXR low-cost, small-footprint training device at I/ITSEC 2018. (Photo: L3 Link)

‘These new technologies will include lower-priced simulators that give students a chance to focus on certain elements of learning with different levels of fidelity and with some intelligent tutoring,’ Hayward explained.

According to TRU, this approach allows more advanced students to learn, demonstrate their knowledge and competence, and move on while conversely providing trainees who may be struggling with knowledge or a skill more time to learn and practice.

‘We are seeing, through our IR&D [independent research & development] investments, that new technologies like virtual reality, augmented reality and small-form-factor visual domes have a place in the continuum of rotary-wing training devices. They would augment, not replace, the existing fixed-base and motion simulators,’ said Hayward.

But it is not just helicopters; many companies are pushing these new-generation devices for fast-jet training, one example being Texas-based L3 Link Training & Simulation.

In December 2018, the company unveiled its COTS-based ‘high-fidelity, mixed-reality, deployable training simulator’ known as Blue Boxer Extended Reality or BBXR.

Lenny Genna, L3 Link Training & Simulation president, told *ITEC Daily News* that by using COTS technology, and the company’s knowledge of the integration of such technology, ‘we’ve used our expertise, combined with that of feedback from the military, to provide a solution that addresses a wide range of military training requirements’.

Genna went on to explain that ‘this deployable training system was developed based on direct feedback from operators who need a networkable trainer that is lower cost, lighter weight and in a form factor attractive to the most space-constrained users such as aircraft carriers or expeditionary airfields’.

Changing approaches

There is no doubt about it, the formulaic and linear approach to training is changing as the modern student tends to want to train at a time that fits with them. Clearly, using live assets is dictated by the availability of platforms, instructors and support elements, but as far as STE is concerned, why cannot training devices be made more freely available?

This is certainly the aim of many of the OEMs that are championing their wider adoption.

Another call that is growing in volume comes from the modelling and simulation as a service (MSaaS) quarter.

In a nutshell, MSaaS is about flexible simulation, the ability to re-use and re-purpose software, to be able to rapidly reconfigure simulators and to draw software from the Cloud to enable this to take place. Such an idea has merits, not least of which is to be able to realise cost savings.

Despite the challenges that lie ahead, the use of low-cost, deployable and, perhaps, re-configurable training devices is alluring in many ways. The high-end FMS would always be there, perhaps in less numbers, and so its relationship with the real platform and the sophisticated high-end training that it brings would not be lost.

What the new devices would bring would be mass to allow more pilots to train using techniques that may be able to achieve 80 or 90% of what can be achieved on the FMS.

Emerging technologies

But the new type of training device that now seems to be emerging is not the end of the story. Companies like CAE and Frasca are adding technologies to enable trainees to maximise their

STE expertise and draw the optimum benefit from time spent in the training device.

Frasca, for example, has developed its SimAssist software module, following an internal R&D project. SimAssist is designed to provide a guided experience for self-paced learning in the simulator, most notably its new TH-57 ab-initio helicopter flight training devices for the USN.

It has been likened to a software ‘adjustable stability augmentation’ system that can manipulate either the flight model itself, the flight controls or both, depending on the

level of assistance the system detects in terms of helping the student to learn certain manoeuvres such as hovering or landing in confined spaces.

Some old-school aviators might probably deride the system, but if it gets ab initio students to complete challenging tasks such as hovering or landing quicker and with more confidence, there is little to argue against.

Again, technology is aiding simulation as seen with CAE’s Rise product. Rise is a data-driven training system that is designed to enable military instructors to deliver standardised training and give them a new toolset to assess pilot competencies more objectively, using live data during training sessions.

The system leverages big data analytics to reduce subjectivity in pilot assessment, allows instructors even greater focus on teaching and helps to create more efficient and continually improving training programmes.

Training methods and technologies never stand still and despite the inherent conservatism in the military training sphere, changes are taking place and will continue to do so over the coming years.

A head for depths



The MK29 Mixed Gas Rebreather system will conserve helium (which is a valuable natural resource), accelerate the deployment of USN divers and increase safety. (Photo: US DoD)

Longer missions, better underwater visibility and more accurate navigation are just some of the goals targeted by specialist suppliers to the military diving community. **By Helen Haxell**

Whilst UDT 2019 is focused on the technologies that enable military personnel to conduct operations, it is also concerned, particularly at this year's event, to put a further focus on the operator and the challenging, and sometimes dangerous, situation that combat divers undertake missions in.

From the dark depths of the ocean to the weight of breathing equipment, military diving creates challenges in a role carried out by personnel spanning the services and is crucial for intelligence, security and recovery missions, among others.

Key concerns

Breathing apparatus for combat divers must be flexible and modular to meet the mission

demands, with particular consideration given to gas levels and enhancing the safety aspect for the operator.

In Q2 2018, the US Naval Surface Warfare Center (NSWC) explored new technologies to enhance the longevity of diving exercises whilst not compromising on safety.

Primarily, the MK29 Mixed Gas Rebreather system, which underwent vigorous testing in April 2018 and continues to be tested, will preserve helium, accelerate the deployment of navy divers and increase safety.

The prototype technology has been developed firmly with the naval diving community in mind.

The premise behind the MK29 is to enhance the capabilities of navy divers and accelerate deployments

for missions, including underwater rescues, EOD, ship hull maintenance, recovery of sunken equipment, and salvage of vessels and aircraft.

The impetus behind the research project stemmed from the fact that the navy's divers breathe a mixture of oxygen and nitrogen while on underwater missions, but the nitrogen becomes toxic below 46m.

The MK29 has been designed to tackle this issue. It addresses it through filtering, utilising oxygen-helium passing through a carbon dioxide scrubber, which removes CO₂ and recycles the breathable gases back to the diver.

Test results have shown that this technology can not only help divers perform more dives, but

also stay underwater longer if surface supply gas is interrupted.

Furthermore, the MK29 also reduces breathing noise and fogging of helmet viewports. It also features 3D-printed titanium tubing that connects hoses from the helmet's breathing manifold to the regulator backpack. That titanium reduces the risk of hoses being sliced by sharp or jagged underwater objects.

On the case

It is not just military-funded research projects which are tackling this issue; industry is on the case too and recognises the challenges posed.

However, the research undertaken by bodies like the NSWC naturally influences the development curve explored by

companies. This was recognised by Anders Magnerfelt, managing director at JFD Sweden, who said: '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.'

JFD is a manufacturer of submarine rescue vehicles, equipment and breathing apparatus. In Q4 2018, the company and the NSWCC collaborated on the development of an advanced hands-free combat diver navigation module called Shadow NAV to assist users when in challenging environments by enhancing safety parameters.

Critical to mission success is having accurate underwater compass and depth readings to assist with navigation while staying within closed-circuit oxygen rebreather depth limits to

prevent oxygen toxicity, which can present significant health risks to the diver. Current handheld or tactical swimboard-mounted compasses, depth gauges and chronometers are of little use in a zero-visibility environment.

The Shadow NAV is fitted to a diver's standard half-mask and provides a clear visual display of the wearer's compass heading, depth and time even in near-zero visibility conditions.

Through using a mask-mounted head-up display, combat divers are not restricted by poor visibility in the mission environment and may not need to carry a tactical swimboard.

'Military divers often carry out complex missions in challenging



Interspiro supplies a variety of diving systems, from FFMs to rebreathers. (Photo: Interspiro)

Shadow Excursion is used for diving missions beyond the safe depths of oxygen. (Photo: JFD)



environments with high stakes where the cost of any error or incident can be severe; safety and [operational security] is paramount to requirements,' Magnerfelt said.

He addressed this further: 'There are limitations for the divers and it's mostly to combine the physics and the faces around the divers... 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.'

Human factor

In this same vein, the human factor continues to be crucial in the development of diving capabilities to ensure that the operator remains central to design, enabling effective and safe utilisation of equipment, an idea shared by David Sylwan, product manager for diving at Interspiro, who commented: 'We think that the technology is sometimes used to create very complicated products, which are safe in theory but can be difficult to handle in an emergency situation. Due to this, it's important to consider the human factor when designing. Sometimes less is more.'

Continuing with this theme, Sylwan delved into the psychology of the divers in the underwater environment and how technologies can evolve and respond to this challenge. 'There

are a lot of studies showing how people behave in panic situations or under stress. We must have this in mind when designing equipment... Therefore, it [technology] must be simple and the procedures for handling emergency situations must be a part of the daily diving procedures,' he noted.

Interspiro provides a range of diving systems from the Divator full-face mask (FFM) and RS4 regulator to the DP1 high-pressure surface supply system and the IS-Mix semi-closed rebreather.

The Divator FFM and RS4, according to company literature, work under the pressures of extreme cold conditions without equipment being impaired for the diver. The FFM has low dead space volume to reduce CO₂ build-up; it is also equipped with a purge button to drain water from the mask if needed. To aid endurance, it has low breathing resistance and high airflow capacity.

In meeting the technical demands of divers, Sylwan said that in the future, trends to ensure safe dives will incorporate enhanced responsive systems. 'We think it will be what we call "ergonomic redundancy" which means to have user-friendly technology, which will prevent accidents from happening and if they still happen it will minimise the risk of further mistakes in such a stressful situation. This does not mean to necessarily double all functions,' he said.



Saab has taken an evolutionary approach to the Gripen-E's MFS-EW and expects to continue refining the design throughout its lifetime. (Photo: Saab)

E for electronic?

While fast jets are generally known for their armed capabilities, modern fighters, exemplified by Saab's Gripen-E in Swedish Air Force service, are increasingly potent as EW platforms. **By Tom Withington**

Unveiled to the world on 18 May 2016, the Saab JAS-39E/F Gripen, dubbed the 'Gripen-E' is the most advanced combat aircraft Sweden has ever built.

It could arguably be said to be the most advanced fighter yet realised on the European continent. From the outset, the Gripen-E has been optimised to fight in highly contested electromagnetic environments where numerous and deadly radar threats reside.

This is vitally important for the Swedish Air Force, which has 60 of the jets on order. The force is facing the front line of Russia's muscular strategic posture in the Baltic and Scandinavia.

Baltic interception

In February 2019, Russia's ambassador was summoned to Sweden's Foreign Ministry in response to the interception of a Swedish Air Force Gulfstream

S-102B Korpen SIGINT gathering aircraft by a Russian Sukhoi Su-27 fighter while in international airspace.

The incident occurred between the Swedish island of Gotland, on the country's southeast coast, and Russia's Kaliningrad exclave.

Kaliningrad is a mere 530km from Stockholm. In March, Russia's MoD announced that it had deployed a single Almaz-Antey S-400 (SA-21 *Growler*) high-altitude surface-to-air missile battery to the area.

The 92N6E (*Grave Stone*) ground-based air surveillance radar accompanying an S-400 battery can already see three quarters of the distance to the Swedish capital thanks to its 400km instrumented range.

Away from northern Europe the US- and subsequently NATO-led operations *Odyssey Dawn/Unified Protector* in 2011 mounted to protect Libyan civilians from forces loyal to that

country's erstwhile dictator Col Muammar Gaddafi saw the Swedish Air Force perform its first combat operations for more than 40 years.

This saw the deployment of five JAS-39C Gripens from Sigonella air base in Sicily. The aircraft assisted reconnaissance and intelligence-gathering. While the Libyan Army certainly lacked SAMs of the sophistication now housed in Kaliningrad, its Soviet-supplied systems such as the NPO Almaz S-200 (SA-5 *Gammon*) and S-75 Dvina (SA-2 *Guideline*) medium- and high-altitude missiles were treated with the utmost respect by NATO aircrews.

Against this stark backdrop of an increasingly outward-looking strategic posture, and a restive neighbourhood, the Swedish Air Force will face these paradigms with an aircraft boasting enviable electromagnetic sophistication.

Embedded ensemble

At the heart of the Gripen-E's EW attributes is its Multifunction System-Electronic Warfare (MFS-EW) ensemble, also developed by Saab. The MFS-EW contains several components intended to counter contemporary and emerging RF threats in the form of ground-based, naval and airborne surveillance and fire control radars, and missile active radar homing systems.

Although its capabilities are classified, the MFS-EW is thought to be capable of detecting and geo-locating RF signals across a waveband of at least 2-18GHz. This may have been increased downwards to 0.5GHz and upwards to 40GHz.

The downward extension would allow the aircraft to detect emissions from low-band ground-based air surveillance radars: Russia's Almaz-Antey 55Zh6ME Nebo-ME air surveillance complex includes a radar transmitting in a VHF waveband.

Such frequencies are useful in detecting aircraft with low radar cross-sections. While they may not be able to provide an accurate enough fix to guide a SAM or AAM to a target, it would give the user an idea of the target's location and track.

Extending the waveband to 40GHz would allow the MFS-EW to detect signals transmitting in the so-called millimetre waveband of 30GHz and upwards.

These wavebands are increasingly being used for weapons guidance and fire control as they can track a target with a high degree of precision, using comparatively small antennas easy to install in missile airframes.

Wider band

'We can see threats and counter them in a much wider frequency band than before,' noted Kristoffer Broqvist, project manager for survivability and EW for the Gripen-E at Sweden's Defence Materiel Administration.

Broqvist is presenting a paper entitled 'Achieving the Operational Goals of the Gripen-E EW System' at this year's AOC EW Europe conference.

Compared to the Saab EWS-39 EW system equipping previous marques of Gripen, notably the JAS-39C/D, he stated that the MFS-EW can 'counter a lot more RF threats simultaneously'. Thanks to the high effective radiated power (ERP) of the MFS-EW, it can achieve 'much shorter burn-through ranges for threat radars'.

The ERP is the measurement of how much jamming power will

end up at the jammer's target. RF signals lose their strength the further away they travel from their source, much as a torch is dimmer when viewed from several metres away, compared to pressing one's eye up against the bulb.

Understandably it is imperative that the jamming signal is as strong as possible at the targeted emitter. The burn-through range is the distance from a targeted radar at which jamming is no longer effective. This means any object within the burn-through range can be seen.

Put simply, the shorter a jammer's burn-through range, the closer an aircraft can get to the radar while concealed behind its cloak of jamming.

Broqvist continued that the MFS-EW employs an AESA architecture. The attributes of AESA are well documented in the radar world. Here arrays comprise multitudes of transmit/receive modules.

These act as miniature individual radars, and can be used electronically, rather than physically, to steer a radar's transmissions, which also allow the radar to rapidly switch between different tasks such as air-to-air or air-to-surface surveillance, or perform two or more modes simultaneously.

In the EW world, AESA allows systems to engage several threats

simultaneously. These could include a fire-control and ground-based surveillance radar, for instance.

Given the beam-steering capabilities offered by AESA, the MFS-EW may be able to electronically direct its jamming in the best way to jam a threat while allowing the aircraft to remain beyond the radar's line of sight, its 'main lobe' in EW jargon.

This can be achieved by directing jamming into the radar's sidelobes. All radars produce a fan-like pattern of transmissions which flank either side of the main lobe, which is used for detecting and tracking a target.

Directing jamming into the sidelobes allows electronic attack to be performed without the aircraft having to expose itself to the radar's main lobe, and hence detection.

Targeting techniques

Cooperative targeting techniques are a key arrow in the MFS-EW's quiver, allowing 'coordinated jamming' said Broqvist: 'Several Gripen-Es can use their MFS-EW apparatus to jam the same threat with cooperative jamming techniques.'

The level of threat direction-finding and geolocation detail provided by the MFS-EW will allow

it to 'act as a targeting sensor in a way that is not possible with the Gripen-C/D'.

Consequently, highly detailed co-ordinates of an electronic threat could be gathered by the MFS-EW of sufficient quality to allow that threat to be engaged kinetically, as well as electronically.

Broqvist expects the MFS-EW to continually evolve throughout its service life. Asked if its development is now complete, he replied: 'No, it is not, and in fact it will never be... The way we see it, the system will never be finished since there is enormous potential in the hardware. The functionality is mostly driven by software or firmware.'

This will allow the continued improvement of the MFS-EW's capabilities, and the threats it can engage, throughout its service life: 'Our intention is to work continuously with exploiting the potential by working with firmware and software updates. When it comes to EW the devil really is in the detail.'

'By letting a small team continually work with the system, both with optimising existing functionality and/or adding new functionality, we can get tremendous operational gains for a rather low cost.'

The Gripen-E is being delivered in two standards; Version-21 and Version-22. Deliveries of Version-21 jets will commence from 2021, with all aircraft being brought up to the full Version-22 standard by 2026.

The Version-22 configuration will include the full MFS-EW fit.

The work performed on the MFS-EW could pay dividends beyond the Gripen-E. In 2017 Saab unveiled its Arexis jamming pod.

This is designed to equip combat aircraft with both a self-protection and escort jamming capability in the same box. Reports have stated that technology developed for the MFS-EW has been employed in the Arexis. Ground qualification of the Arexis pod, ahead of expected flight trials, commenced this March.



Technology developed for the Gripen-E's MFS-EW has been folded into the design of Saab's new Arexis self-protection and escort jamming pod. (Photo: Saab)

A selection of some of the items on display at ITEC 2019.

Photos by Helen Haxell



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