VOLUME 21 NUMBER 3 MAY/JUN 2019

A SHEPHARD MEDIA PUBLICATION

MTSN

Seahawk skills

Training the RAN's MH-60R crews

AIMING HIGHER
Aerial targets

LIVE LESSONS
Tactical engagement

GLOBAL VISION
Visual databases

SHEPHARD

WWW.MILTRAINSIM.COM


PROVEN PAST PERFORMANCE
99.2% AVAILABILITY RATE FOR B-1
99.5% AVAILABILITY RATE FOR C-17
100% QUALITY ACCEPTANCE FOR F-22
TRU SIMULATION + TRAINING
A Textron Company
SAVE THE BATTLES FOR THE FIELD.
JOIN FORCES WITH TRU AND EXPERIENCE A TOTAL TRAINING SOLUTION.
Go from mission ready to mission complete with total training solutions from TRU Simulation + Training. Through proven performance in LVC, DMO, Cybersecurity and CLS, we've developed a system to create an experience that is seamless from training to aircraft. TRU's design and support of devices, aircrew instruction, self-guided courses and access to mission scenarios, before ever entering the aircraft allows aircrew to remain battle-ready.
TRUsimulation.com/Military
TRANSFORM YOUR REALITY
© 2019 TRU Simulation + Training Inc. All Rights Reserved. The appearance of U.S. Department of Defense (DoD) visual information does not imply or constitute DoD endorsement.

MTSN

Editor
Trevor Nash
trevor.n@shephardmedia.com

Editor-in-Chief and Sea Editor
Richard Thomas richard.t@shephardmedia.com
Tel: +44 (0)20 3179 2591

Air Editor
Helen Haxell helen.h@shephardmedia.com

Deputy Editor – Land
Beth Maundrill beth.m@shephardmedia.com

Asia-Pacific Editor
Gordon Arthur
gordon.a@shephardmedia.com

Senior Staff Reporter
Tim Martin

Staff Reporter
Kate Martyr

Editorial Assistant
Lukasz Furmaniak

Contributors
Gordon Arthur, Dr Joetey Attariwala, Angus Batey, Alan Dron, Scott R Gourley, Tim Mahon, Peter Matthews, David Oliver, Miles Quartermain, Richard Scott

Production Manager
Georgina Smith

Junior Production Editor
Sirli Manitski

Publishing Assistant
Malika Kingston

Digital Development Manager
Adam Wakeling

Graphic Designer
Georgina Kerridge

Advertising Sales
advertising@shephardmedia.com

VP Operations
David Hurst

VP Business Development
Mike Wild

VP Content
Tony Skinner

CEO
Darren Lake

Chairman
Nick Prest

Subscriptions
Annual rates start at £90
Tel: +44 (0)20 3179 2592
Email: subs@shephardmedia.com
Web: shop.shephardmedia.com

Military Training & Simulation News is published six times per year by The Shephard Press Ltd, Saville Mews, 30 Saville Road, London, W4 5HG, UK. Subscription rates start at £90. PCM CitySprint is acting as mailing agent.

Print: Buxton Press, Derbyshire, UK

ISSN 1366-2309

The Shephard Press Ltd
Saville Mews, 30 Saville Road,
London, W4 5HG, UK
Tel: +44 (0)20 3179 2570

Member of

WWW.MILTRAINSIM.COM

CONTENTS

Front cover: A Royal Australian Navy MH-60R lowers its AN/AQS-22 airborne low-frequency sonar. The service conducts training for the type at HMAS Albatross in Nowra, New South Wales. (Photo: Trevor Nash)

In the next issue

- Simulator upgrades
- Maintenance training
- Motion and control loading systems
- Battlefield effects

Trevor Nash, Editor

Crumbling capacity

Although not the first nation to do so, the UK was instrumental in embracing public-private partnerships (PPPs) when it came to funding large capital infrastructure, transportation and service projects.

The term PPP is the over-arching descriptor of what are normally referred to as private finance initiatives (PFIs), whereby industry fund these projects instead of governments. In the UK, the PFI concept was introduced in 1992 by the Conservative government and in 1997, under New Labour, the process was expanded.

Political priorities

The allure of PFI for politicians is easy to understand – its adoption as a procurement model removes the need to fund large projects and allows the costs to be spread over a number of years. In theory, PFI provides cost savings and reduces risk for the government. However, as with any major project, the outcome is only as good as the planning data that is applied during the insipient discussions with the provider.

For example, many schools and hospitals created under the PFI concept in the UK have failed because of changing strategic directions of local authorities and the national government. In 2018, the National Audit Office reported that PFI models were more expensive and far less efficient in providing schools, hospitals and other public infrastructure than conventional procurements.

Surely, this cannot be the case for military PFI projects? The UK's Military Flying Training System (MFTS) programme was awarded in 2008 as a 25-year PFI programme that saw the contract winners Ascent (a JV between Lockheed Martin and VT Group, now Babcock International) working with the RAF's 22 Group to provide aircrew training for the UK MoD.

They say a week is a long time in politics, and in military planning, 25-years is an eon, especially when that planning is thwarted by changing political priorities and ill-judged decision making.

These changing political priorities are exemplified by the UK's Strategic Defence & Security Reviews (SDSRs) of 2010 and 2015.

In essence, SDSR 2010 scrapped Nimrod and Harrier aircraft and reduced the numbers of British Army helicopters as well as RAF Tornado and Typhoon fixed-wing platforms. Five years later, SDSR 2015 added the Boeing P-8 Poseidon and extended the in-service life of the Lockheed Martin C-130J transport aircraft and the Raytheon Sentinel surveillance platform. It also introduced the Protector UAV procurement and the idea of two new Typhoon squadrons – from famine to feast in five years.

Flawed strategy

The MFTS programme is now running over four years late, and the problems currently being addressed by Ascent and 22 Group are enormous. Over the past three years, the number of pilots awaiting a place on their next course in the training pipeline (referred to as holding) has increased from fewer than 20 to 350, and it is all about a lack of capacity.

Trying to break the logjam, MFTS is sending multi-engine pilots to Bournemouth, Dorset, to carry out training provided by L3 Commercial Training Solutions on the Diamond DA42 instead of the MFTS Phenom 100, representing a clear training shortfall.

Fast-jet pilots for the advanced jet training phase normally train at RAF Valley on the glass-cockpit Hawk T2, which is fitted with an embedded training system. To help clear the number of fast-jet pilots currently holding, spare capacity on the RAF's analogue Hawk T1 (normally used for target towing and adversary training) is being used. Later this year, other fast-jet students will be sent to the US to train as part of the Euro NATO Joint Jet Pilot Training programme in Texas.

It is salutatory to consider fixed-wing training further in terms of the number of aircraft available for basic training. Although the UK MoD has reduced its aviation assets considerably over the years, compare the numbers during the past 30 years: in 1988, the RAF accepted the first of 130 Tucano T1 aircraft; in 2018, the RAF's Tucano fleet stood at 38, although not all were used for basic training. Under MFTS, the Tucano has been replaced by ten T-6C Texan II aeroplanes.

Servicing and availability considered, how many of these platforms will be on the ramp and available for training at any one time? A clear lack of capacity driven by flawed strategic planning has hampered MFTS throughout and reflects poorly on military PFIs. ■

Lockheed Martin wins prestigious ADF Core Simulation Capability


Photo: Calytrix Technologies

Negotiations have been completed for the Australian Defence Force's (ADF's) JP9711 Core Simulation Capability requirement, and Lockheed Martin Australia, alongside partners Calytrix Technologies and NEC Australia, have now been placed under contract by the Canberra government.

Lockheed Australia was down-selected for the programme around 18 months ago at the expense of a Northrop Grumman and CAE team. Northrop Grumman provides the current USAF network infrastructure for its distributed training (LEXIOS), while CAE has been responsible for facilitating RAAF participation in *Virtual Flag* exercises over recent years.

JP9711 seeks to provide a networked training capability for the ADF that allows it to provide a common and coherent training environment for its simulation assets. In many ways, the project mirrors the US Distributed Mission Operations Network as well as aspirational programmes such as the UK's DOTC(A) (Defence Operational Training Capability – Air) and the US Army's Synthetic Training Environment. In essence, these aim to provide distributed and integrated training capabilities that enhance multi-force collective training scenarios.

'The addition of fifth-generation capabilities such as the F-35 and Aegis means that Australia has one of the most modern defence forces in the world,' said Vince Di Pietro, chief executive at Lockheed Martin Australia. 'JP9711 will transform the ADF's approach to training and simulation, ensuring the latest technologies are used to best prepare our service personnel for the complexity and challenges of the future.'

As for its partners, Calytrix will be using a 'development of its… [Titan] virtual 3D training software as a core element' of the JP9711 Core Simulation Capability (see p36), while NEC Australia is providing the information and communications technology infrastructure.

Lockheed's involvement with the USAF's Distributed Mission Training programme that it has been supporting over the years will certainly underpin and assist its approach to JP9711. This is still a challenging programme and will be watched closely by those responsible for the DOTC(A) and STE.

By Trevor Nash, London

Malaysian Hawks await upgrade decision

Hawk trainer jets of the Royal Malaysian Air Force (RMAF) will continue to play an important role as they remain in service for another ten to 15 years.

The RMAF held a ceremony at Butterworth AFB in Malaysia in March 2019 to celebrate the Hawk's contribution over the past 25 years. Gen Tan Sri Affendi Buang, chief of the air force, said that he believes the fleet is 'capable of delivering and remaining relevant'.

More than 140 Malaysian fast-jet pilots have trained on the RMAF's Hawk 108 twin-seat trainer. The single-seat Hawk 208, meanwhile, serves as a lightweight, multirole combat aircraft.

The nation took receipt of its first Hawk in April 1994 and a total of 18 208s and ten 108s entered service. Today, there are 13 and five aircraft remaining, respectively.

Mike Swales, Hawk international director at BAE Systems - Air, said: 'We now look forward to [the type] continuing to provide more highly trained pilots for the RMAF for many years to come. The RMAF Hawk is a tremendous example of how, working in partnership, industry and the armed forces can deliver an outstanding air force asset, while at the same time helping to develop industrial and economic benefits for Malaysia.'

Swales told *Shephard* that although the airframes are designed to last for up to another 15 years, BAE is discussing with the RMAF the implementation of upgrades such as a radar warning receiver, chaff and flare dispensers, digital video and mission planning/debriefing system.

Two years ago at LIMA 2017, BAE announced a tie-up with Malaysian company Airod to offer an upgrade programme to the RMAF, with work on the fleet set to take place at Kuantan. Swales noted that this project for single-seat Hawks was on the verge of being signed before the Malaysian government changed last year, essentially putting the upgrade proposal on ice.

The RMAF's fighter woes are well documented – with the MiG-29s now grounded plus availability issues with the Su-30MKM – meaning that the Hawk has had to play a critical role in protecting Malaysian airspace. With the MB-339 trainer jet fleet also grounded, the training syllabus is heavily reliant on the Hawk twin-seater.

Although BAE was not among the vendors invited to bid for the RMAF's recent RfI for a light combat aircraft, Swales said that the Hawk is capable of the light combat role. However, questions remain as to why Malaysia is pursuing such a platform. It is doubtful that the nation could fund both a light fighter and a more capable fighter under the long-awaited Multirole Combat Aircraft (MRCA) requirement. Moving forward with the former will push acquisition of the MRCA much further into the future.

BAE displayed a full-scale replica of the Typhoon twin-engine fighter at LIMA 2019 as part of its long-running campaign for the MRCA requirement.

By Gordon Arthur, Langkawi

Australian Army training progresses from first DATE

Australia is adopting a new training approach with the introduction of the Decisive Action Training Environment (DATE), a concept and name that the US Army introduced around a decade ago, and which was subsequently adopted by both Canada and the UK.

The supposition of DATE is that the Australian Army will be able to train against a dynamic and free-thinking enemy, with DATE becoming the service's standardised training system aligned with a multinational framework. A spokesperson from the Australian Defence Force (ADF) told *Shephard* that DATE is a 'modernisation initiative.. to improve the quality of training to meet the needs of the government'.

They added that DATE was initially adopted by the army in 2017, and it is expected to be fully integrated by 2020. 'With support from the US Army, DATE has been progressively adopted across all Australian Army units, brigades and training centres. It continues to be trialled through selected training environments, including the army's major 2018 training activity, Exercise *Hamel*,' explained the spokesperson.


Photo: ADF

In major exercises such as *Talisman Sabre*, Australia has long used a construct of a fictitious nation and foe known as Musoria that uses Russian-origin equipment. This same enemy has been confronted for the past 30 years or so. However, DATE will attempt to throw open the gates so that the army must now confront a flexible adversary amidst increased uncertainty, including the cyber and information realms. This is clearly an effort to immerse Australian soldiers in a hybrid warfare environment, whilst practising near-peer and counter-insurgency missions.

The spokesman said: 'Using the latest simulation and training technologies, DATE includes two key aspects – a fulsome fictional world to help with scenario development and a vast suite of hostile forces.'

As Australia implements DATE, the army will be able to train in common scenarios with allies like the US. It can also access existing databases related to training scenarios, of which the US Army has four. The first, covering the Caucasus region, was ready in 2011, and it was later joined by DATEs covering the regions of Europe, Pacific and Africa.

The ADF spokesman confirmed: 'DATE is supported by research and resources from international partners in the UK, Canada and the US.'

Brig Ben James, the army's director general of training and doctrine, explained: 'In order to be able to deal with a variety of current and emerging threats, the army must be able to train in challenging and realistic environments. Our soldiers and their officers must be able to think and act decisively in situations of chaos and uncertainty in environments that are ambiguous. That is why the army decided to implement DATE.'

DATE will act as a common training environment for all individual and collective training. Gone is the enemy Musorian doctrine and construct, which is replaced by a mix of regular, insurgent, guerrilla and even criminal threats that are based on real-world threats. James added that DATE 'offers a rich, fictitious operating environment, bringing greater context to our exercise and training scenarios'.

The first large-scale application of DATE will be Exercise *Talisman Sabre 2019*, where elements of the Brisbane-based 7th Brigade will employ DATE TTPs to provide more realistic training for the Darwin-based 1st Brigade that is now in its readying cycle.

'Through reflecting modern enemy and combatant capabilities and responding to increasingly sophisticated changes in the real world, DATE will ensure the army is prepared and ready for the future,' the ADF concluded.

By Gordon Arthur, Hong Kong

Black Hawk simulator for Saudi Arabia

Collins Aerospace has been awarded a $30.95 million firm-fixed-price FMS contract for production of a Transportable Black Hawk Operations Simulator (T-BOS) training device for the Saudi Arabia National Guard.

T-BOS is a high-fidelity, containerised flight simulator that uses operational flight programme software and is capable of being deployed to forward operating bases. The system is transportable by air, land and sea and can be ready for training within 8h of arrival due to its integral power supply and environmental control unit. The T-BOS is equipped with UH-60M avionics including Collins Aerospace cockpit displays. It is fitted with a PC-based image generator and a vibration platform.

Originally developed for the US Army and Army National Guard, the device can simulate UH-60L and M variants. Swapping between the two takes 4h. Over 30 devices have been fielded by the two services.

This contract was awarded by the Orlando-based US Army Contracting Command and was a sole-source selection. As well as Saudi Arabia, which will have its T-BOS ready for training in early 2024, other Middle Eastern customers include Bahrain and the UAE. Ongoing T-BOS business provides long-term income for Collins Aerospace and mirrors that provided to Boeing by the AH-64 Longbow Crew Trainer (LCT). Both the T-BOS and LCT are the programme-of-record training devices for the two platforms and have become the standard training tool for FMS customers.

By Trevor Nash, London

For more news, visit
www.miltrainsim.com

CAE offers new recurrent courses at Dothan


Photo: author

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

CAE announced at the US Army Aviation Association of America (Quad-A) event that it has extended its course offering to provide three- and five-day recurrent training courses on the C-12 (Beech King Air 200) as well as upset recovery training.

The five-day C-12 recurrent/refresher course is already offered under the US Army's fixed-wing contract, but the company is now extending that to other military operators as well as to US Army units that have not been able to secure slots under the existing fixed-wing contract.

The three-day recurrent course is new and is being offered for the more experienced C-12/King Air pilots who don't necessarily need a full-week recurrent/refresher course.

In addition, a three-day Upset Prevention and Recovery Training (UPRT) course is being offered in partnership with Aviation Performance Solutions (APS).

The three-day UPRT provides a comprehensive understanding and practical live aircraft training in CAE's Grob G120TP aircraft to address loss of control in flight, one of the leading causes of aircraft incidents globally. The course provides students with the awareness and understanding to recognize, prevent, and if required, recover from unusual attitudes in an aircraft.

APS has always been part of the US Army's fixed-wing flight training programme and has worked alongside CAE since DTC started training its first pilots in 2017. APS has also worked with CAE on the civil flight training side of the business, offering UPRT courses at CAE flight schools.

The three- and five-day C-12/King Air B200 recurrent/refresher courses include academic ground school training, brief/debrief sessions and full-flight simulator training in CAE-built C-12/King Air B200 simulators. There are three different cockpit configurations available for full-flight simulator training that include the Collins Aerospace Proline 21, Collins Aerospace Proline 2 and Universal (UNS-1F).

DTC is home to the US Army's Fixed-Wing Flight Training programme that provides the training required to fly the service's fleet of more than 350 fixed-wing platforms. As prime contractor, CAE provides academic, simulator and live-flying training using CAE-owned Grob G120TP and army-owned C-12 aircraft.

By Trevor Nash, London

New VITAL IG launched by FSI

FlightSafety International (FSI) has introduced its new VITAL 1150 image generator (IG), which replaces the VITAL 1100 that was introduced in late 2013.

The new system can render normal rates of 120Hz with up to 8K resolution to provide a much higher resolution than its predecessor. According to the company, this provides 'the sharpest visual quality throughout the entire flight envelope encountered during training'.

Reflecting the increasing requirements for networked training, FSI has added new features for advanced information assurance that support current and future cyber-security requirements. In terms of its more technical aspects, 'VITAL 1150 incorporates advanced rendering techniques for enhanced weather scenarios, including new cloud simulations using specialised elliptical shading that improve the 3D visual effects for added realism', said FSI.

One significant aspect of the new system is its ability to bypass the conventional host computer within the flight simulator and directly interface with the protocols in the distributed mission operations (DMO) network.

Jim Wheeler, general manager of visual systems at FSI, explained that this provides 'improved realistic animations and ease of network integration... for extensive DMO & LVC events,

The company said that VITAL 1150 is also designed for use with its immersive mixed reality system, as well as unmanned systems and night vision goggle (NVG) training. VITAL 1150 has been designed to adjust projector features dynamically in real time in conjunction with image adjustments within the IG, which provides night and NVG environments.

A variety of NVG equipment is supported, and the IG has dedicated channels to stimulate actual NVG equipment if used with suitable projectors.

VITAL 1150 clearly raises the visual fidelity bar by another notch. *Shephard* understands that the new system has been offered on a number of emerging simulator programmes, both domestically and overseas.

By Trevor Nash, London

When accuracy counts, use MetaVR 3D real-time visuals and geospecific terrain for your mission planning and rehearsal

- "Razor 55 I'm set to your PRF code of 1111 and again looking for one GBU-12 on the three enemy personnel."
- "Copy …. Ten Seconds."
- "Razor 55 Cleared Hot."
- "Heartless 44, Laser on."
- "Lasing 1111."

Real-time screen captures of the modeled virtual terrain of Kismayo, Somalia, are from MetaVR's visualization system and are unedited except as required for printing. The real-time renderings of the 3D virtual world are generated by MetaVR Virtual Reality Scene Generator™ (VRSG™). All 3D models and animations are from MetaVR's 3D content libraries.

METAVR

www.metavr.com

ASDOT is no more

With the finishing line in sight, the UK MoD's Air Support to Defence Operational Training (ASDOT) programme has failed the acid test of the Main Gate investment decision. This covered the initial £495 million ($641 million) ten-year contract, although the overall value of ASDOT was thought to be closer to £1.2 billion over the lifetime of the project.

The final three bidders – with the Thales team having pulled out in October 2018 – were told of the decision on 18 March. This consortia comprised Babcock/Elbit; Cobham/QinetiQ/Draken International; and Leonardo/Inzpire/Top Aces.

All of the teams were thought to be well over the UK MoD's budget for the programme, and their bids largely reflect the costs of setting up a new and unique training enterprise. This mismatch in price and delivery expectations between the purchaser and the vendors is worrying and raises serious issues.

ASDOT was a massively complex project that was aimed at pulling together the UK MoD's air delivered live training that was to cover dissimilar air combat, forward air controller, EW, ship attack and target-towing training capabilities. However, as reported many times by *Shephard*, ASDOT should not have been considered in a vacuum.

The programme has been running in parallel with a number of other equally challenging air requirements, not least of which was the Defence Operational Training Capability – Air (DOTC (A)) Core System and Services (CS&S) programme, the first phase of a virtual network allowing the RAF to conduct distributed training.


Photo: Top Aces

It is understood that Boeing has been selected for this programme as the preferred bidder, although the demise of ASDOT will surely affect the timescale and scope of that eventual contract.

Add to DOTC(A) CS&S the Future Air Combat Manoeuvring Instrumentation System (FACMIS) and the Typhoon Future Synthetic Training (TFST) requirements, and it becomes clear that the UK's RAF and Defence Equipment & Support procurement organisation had its hands full.

Looking more widely, the ability for the UK MoD to manage such complicated training requirements is again under the microscope. With the UK Military Flight Training System (MFTS) now having to outsource flight training to civilian flight training schools, train some fast-jet pilots on old Hawk T1 aircraft and send others to the Euro-NATO Joint Jet Pilot Training school at Sheppard AFB, Texas, due to a lack of capacity within MFTS training pipelines, questions must be asked about the UK MoD's ability to manage large and complex public-private partnerships.

Returning to ASDOT, the requirement for live training is still there, and the UK MoD has said that it is looking at other options. The programme was not being delivered on its own. DOTC(A) CS&S, FACMIS and TFST will all be impacted in one way or another, as will industry's confidence in dealing with the UK MoD.

By Trevor Nash, Bristol

USMC in DTC first

Normally associated with networking air assets, Northrop Grumman's Distributed Training Center (DTC) located at Joint Base Langley-Eustis, Virginia, has been used for the first time by the USMC to train for close air support (CAS) missions.

During two exercises, eight F-15E Strike Eagle aircrew based at Mountain Home AFB in Idaho trained with four marines from Joint Base Lewis-McChord in Washington, DC, via the DTC network. The marines, trained as JTACs/Joint Forward Observers (JFOs), are part of the 6th Air Naval Gunfire Liaison Company (ANGLICO), tasked with calling-in air strikes and artillery fire in support of their attached formation.

ANGLICO JTACs support SOF and typically deploy to the battlefield in small teams.

According to Northrop Grumman, company personnel supported each training scenario that took place using LVC assets.

'The marines were impressed with the high-fidelity training and said the customised scenarios felt like real life,' said Martin Amen, director of secure network operations at Northrop Grumman.

During the two exercises, a number of training goals were achieved: creating a joint-service CAS training environment; integrating air support and ground fire missions; air-ground de-confliction; monitoring enemy aircraft; and the use of different types of ordnance.

The DTC has provided LVC training for the USAF for nine years, and is based on Northrop Grumman's LEXIOS (LVC Experimentation, Integration and Operations Suite) architecture.

Although this is the first time that the DTC has been used by the marine corps, last year the US Army Rangers took part in DTC exercises prior to operational deployment.

The company said that its Distributed Mission Operations Network (DMON) was developed in 1999 and 'provides the connectivity and network interoperability for the DTC, which became operational in 2010 to meet the need for real-world scenario development and advanced warfighter readiness training'.

Exercises with the DTC for the US Army and marines matches Northrop Grumman's expansion plans for the use of the DMON and DTC both at home and overseas.

By Trevor Nash, London

The Airbus Defence & Space Do-DT25 has a maximum speed of 300kt and can carry a variety of payloads to enhance its signature. (Photo: Airbus Defence & Space)

AIMING HIGHER

New aerial targets with greater capabilities and higher speeds are entering the market as the training requirements of militaries worldwide transition to cope with higher-performance threats. **By Alan Dron**

As Western nations move away from counter-insurgency warfare and back towards training for near-peer conflicts, the requirement for aerial targets – particularly faster ones – is growing rapidly. This is proving to be good news for target manufacturers, which are poised to introduce new platforms into service.

Arising requirements

One particular concern that has increasingly been exercising the minds of defence planners in recent years has been the dawning realisation that the navies of both China and Russia not only outrange their western counterparts when it comes to anti-ship missiles, but are deploying systems with supersonic or even hypersonic capabilities.

This has triggered the need for speedier targets against which ships' crews can practise defensive actions. Among the companies that have responded to this demand are Qinetiq Target Systems (QTS) and Kratos Unmanned Systems.

'We've been getting demand [for targets] to go faster and longer [endurance] and to move into a higher-performance sector, in terms of going supersonic,' confirmed Victor Malley, director of business development at QTS. 'We're in the process of developing a new supersonic target, Rattler.'

The first phase of the Rattler programme is a ground-launched variant, with a planned initial operating capability (IOC) of June 2019. With that version now well on the way towards deployment, QTS is now in the process 'of working on an air-launched capability that will be launched from a [QTS] Jet 80 or 80-plus [UAV], to emulate various cruise missiles and anti-radiation missiles, etc', said Malley. 'I can't give away the powerplant on that one, but we've accomplished speeds in excess of Mach 2. Range is dependent on launch and profile. We've been able to achieve various profiles, to replicate different types of missile threats.

'Rattler has been developed in the past couple of years. We've received a lot of market demand, from both existing and new customers. Supersonic and hypersonic ship-to-ship missiles are driving demand for this,' he continued. Nor is QTS pausing at these initial two versions: 'We expect to have a few exciting enhancements to Rattler [to be announced] in the next couple of months,' Malley said. He was unable to give any information on orders, but confirmed that the company has 'had a lot of interest and is very optimistic about customer uptake in the very near future'.

Rattler will join QTS's range of aerial targets that have had great success over the years under the Meggitt brand. These targets include Banshee, Jet 80, Snipe and Vindicator II. The latter is in service with the Canadian Forces and a number of other international customers.

Also looking at the supersonic regime is US company Kratos Unmanned Systems. 'I think the right way to phrase this is that there's certainly interest in that area, and we certainly have capabilities in that area,' said company president Steve Fendley. 'Obviously, we have a full suite of high-subsonic target systems, [and a sister division] develops, supplies and supports ballistic missile targets. So, the capability for us to do that... definitely exists.'

Both companies report that the aerial target market is healthy. 'I would call it very strong right now,' said Fendley. 'We're very pleased. We have three jet target systems in rate production with a variety of US and international customers. We see the trend continuing to grow year on year.'

New projects

Malley is also positive about the market and his company's new products. Over the past year, QTS has launched the latest version of its long-serving Banshee target, the Jet 80plus, described by the OEM as a medium-speed, high-performing target in the low-cost sector.

'We've put on some enhanced engines and increased the endurance and speed,' explained Malley. 'Previously, the Jet 80 [speed] was around 180m/s, so it's a 10% enhancement. It's now in excess of 200m/s for around 45 minutes. That has unlocked a sweet spot in the market at a very attractive price point. The Jet 80plus came about in response to customer demand to enhance the performance characteristics but maintain a very attractive price.' The platform will receive some further enhancements later this year in response to further customer demands.

One significant milestone has been the first deployment of the aircraft that will become the cornerstone of NATO's air strength over the next 30 years, the Lockheed Martin F-35, against some of QTS's products. 'In the last couple of months, we conducted the first set of F-35 flights against Banshee with some NATO partners. It's quite exciting going up against fifth-generation fighters,' noted Malley.

The strength of the market was also confirmed by Martin Normark, CEO of Air Target Sweden (ATS), the acoustic scoring specialist whose miss distance indicators have evolved over several decades. 'It's a very niche market,' he admitted, but added that business prospects for the company seem good. 'We see all the curves pointing in the right way. I would say we're booming, which is good. When I started here, it would be challenging because sometimes this is not the latest technology and functions you would ask for, but we do add value for a customer and add more functions,' Normark said.

In recent years, ATS has been considering moving away from manned target-towing aircraft, and that trend has very much been confirmed. 'We're absolutely moving towards remotely piloted aircraft. I would say that three out of four new projects are aiming at that,' Normark stated.

Most new customers approaching ATS considered its move towards unmanned missions to be a positive factor, he added. Only around half of ATS's missions now involve targets being towed behind a manned aircraft. Increasingly, the company's miss distance sensor technology is being integrated into a missile or unmanned vehicle.

'We don't operate aircraft, we deliver functions and mainly we deliver the miss distance indication function. That's a strategy. We don't want to have our own drones; we don't want to operate the service ourselves. We'd rather partner up with all those players already out there,' Normark explained.

Only 10-15% of ATS's work is for customers in its domestic Swedish market. Of the rest, around 50% is in Europe, the rest worldwide. 'Our biggest customer is actually Japan,' said Normark. 'The miss distance indication function is integrated into different products over there.' Currently, ATS delivers its services to all parts of the world except South America, but it will also shortly be operating in that continent as well, said Normark, but declined to give further details.

However, he commented that the company is also adding new technology to the platforms that carry its miss distance indicators and other sensors. 'As we speak, we're adding GPS and scrambled telemetry capability,' he told *Shephard*.

Modern portfolio

Among other new products that have recently entered the market is Kratos' BQM-177A, a high-subsonic sea-skimmer that achieved IOC recently and will shortly be going into full-scale production, with an annual rate of between 60-80 ▶

Instead of procuring batches of aerial targets, most nations opt for target services where the OEM provides the full gamut of management and support. (Photo: Airbus Defence & Space)

A Kratos BQM-177A leaves the launch pad for a live-fire training exercise. (Photo: Kratos)

aircraft scheduled to be achieved by early 2021.

The target replaces the long-serving Northrop BQM-74 Chukar, whose original variants appeared in the 1960s. 'Our aircraft is slightly larger, with more payload capability,' said Fendley. 'It is substantially more manoeuvrable and substantially faster, particularly in manoeuvring conditions – think about it from the perspective of being able to replicate more advanced threats and take it to the next level of Mach 0.9.'

Kratos has one international customer for the new missile so far, the Taiwanese Navy. This is significant, given the steadily increasing threat posed by mainland China's huge investment in both warships and anti-ship missiles over the past decade.

Two of the major aerial target platforms in the Kratos portfolio are the aforementioned BQM-177 and the -167. Both come in two variants, those for the US Armed Forces having an 'A' suffix, while those for international customers are dubbed 'I'.

'The easiest way to describe the difference [between the BQM-167 and BQM-177] is that they have very similar lengths – 17ft [5.2m] for the BQM-177 and 19ft for the BQM-167 – and effectively the same engine,' explained Fendley. 'The big difference is when you design an aeroplane you optimise it for a certain part of the envelope – the BQM-177 is optimised for the low-altitude cruise missile envelope. It can still fly up to 40,000ft and replicate a fighter aircraft, but it's not optimised for that. The BQM-167, which is primarily optimised for the air force, is [designed] for higher-altitude manoeuvres, carrying more payload and with longer endurance.'

The BQM-167 is in service with France, South Korea, Sweden and multiple other countries, and Kratos is 'on Lot 14 of annual production lots for the US Air Force'. The OEM builds around 30 BQM-167s annually for the service. The target has been progressively modernised and tweaked over that period to increase its threat representation.

Although Fendley believes it unlikely that there will be any forthcoming significant competitions in the US or overseas for Kratos, he emphasised that Kratos is in a good place at present. 'In the past couple of years, we've won all the major contracts. In the past 12 months, there's been an opportunity for an Army Advanced Subscale Aerial Platform, with up to 84 targets over a five-year period. That's a slightly reconfigured version of the BQM-167,' he said.

One programme that is active is the Aerial Target Systems 2 (ATS-2) requirement. In May 2018, four US companies – Griffon Aerospace, Kratos, Kord Technologies and Trideum – were selected by the US Army to compete for sub-elements of a $93.4 million contract for ATS-2 research, development, test and evaluation (RDT&E). Work locations and funding will be determined with each order, with an estimated completion date of May 2023.

ATS-2 is a new contract that fulfils both the initial Aerial Target Systems indefinite-delivery, indefinite-quantity contract and replaces a previous agreement called ENCORE. The deal covers high-performance unmanned aerial target systems support to the army. According to Trideum, ATS-2 tasks will include RDT&E and COTS and non-commercial materials, technical flight, engineering field support, plus logistical and technical support associated with unmanned aerial target systems programmes managed by the US Army's Target Management Office.

Aerial tactics

Airbus Defence & Space is another company producing significant quantities of aerial targets and introducing new models to its portfolio. The company produced its 1,500th target drone in 2017, and by the end of 2018 this figure had reached the 1,700 mark. Airbus has a manufacturing capacity of about 200 drones per year.

> ***A swarm of unmanned systems can provide situational awareness to a mission group commander.***

The OEM sells its targets outright to countries to operate by themselves with the necessary training and ground equipment and also dispatches crews to manage and support training requirements. These can go from a single drone flight to complex tactical air defence threat scenarios.

Airbus has a range of Direct Target (DT) platforms that, as well as serving their primary purpose, can be operated as test vehicles to evaluate and practise tactics. The latest training services added to the DT range include swarming capabilities, for example.

In autumn 2018, Airbus performed a manned-unmanned teaming (MUM-T) test flight campaign in a test zone off northern Germany's Baltic Sea Coast. The campaign included demonstrations of five Do-DT25 target drones controlled from a mission group commander in a manned C2 aircraft.

The MUM-T trial flights had several aims, including validating elements such as connectivity, human-machine interface and the concept of teaming intelligence through mission group management. For the last of these, multiple capabilities and enabling technologies are required at sufficient maturity levels – from teaming/swarming algorithms and new sensors to mission management systems for C2 assistance by the manned aircraft's crew. Equipped with sensors, a swarm of unmanned systems can provide situational awareness to a mission group commander located a safe distance away aboard the manned platform.

Airbus produces a range of four aerial targets: the Do-DT25 medium-speed (300kt) model; Do-DT35 for radar systems with a speed of 350kt; Do-DT45 high-speed (450kt) version; and the Do-DT55 (455kt), which is launched from a Do-DT25 to simulate an air-launched threat, such as an anti-ship missile.

Recent improvements and developments to the range include a new flight controller and the corresponding Ground Control Station, together with new capabilities such as 4D navigation. Additionally, more thrust has been introduced to a new version of the Do-DT45, the Do-DT45X-400, which gives a speed of more than 230m/s. The agility of both the Do-DT45 and Do-DT25 have also been increased, allowing both models to achieve sustained 5g turns without losing either speed or altitude.

Among new contenders in the field is the Mirach M-40 target drone from Italy's Leonardo, which was reported in February to have flown its first live missions for the Italian Navy in a training exercise at an Italian joint armed forces test range. The exercise saw the aircraft carrier *Cavour* and its complement of McDonnell Douglas AV8B+ STOVL fighter aircraft training ▶

The QTS Vindicator II deployed on board a Royal Canadian Navy ship. (Photo: Dr Joetey Attariwala)

alongside the guided missile destroyer *Mimbelli* against M-40s that were simulating a range of threats.

During the exercise, the M-40 played the part of a missile to simulate an attack against the vessels and, separately, acted as a hostile enemy fighter in air-to-air combat scenarios. As part of these missions, Italian Navy personnel were able to 'shoot down' the reusable targets that were towed by the M-40, allowing them to train with weapon systems including Aspide surface-to-air missiles.

Leonardo said that this exercise was the first set of missions to make use of the M-40, which is able to represent a spectrum of radar, IR and visual threats. The OEM further highlighted that the Mirach is able to mimic a variety of aircraft and missiles, and it provides medium to high performance at a price comparable with competitors' entry-level target drones. As the latest development of the Mirach family of drones, the M-40 offers much of the performance of the earlier Mirach 100/5 target at a significantly reduced cost, to help nations increasingly having to 'do more with less' in the face of constrained defence budgets, according to the company.

The drone was authorised for use by the Italian Military Airworthiness Authority in early 2018. Leonardo added that the M-40 is able to perform very low-altitude sea skimming missions, close-formation flights and high-g manoeuvres.

Although traditional target-towing is becoming a distinctly niche activity, Air Affairs Australia continues in that role with its fleet of Lear Jet 35s and 60s for both the Australian and foreign armed forces. The company also developed and operates the Phoenix unmanned target, for which it has an open production line to manufacture examples for the Australian Defence Forces, notably the nation's army.

The next generation

So far, so traditional. What are likely to constitute the next advances in the aerial targets sector?

'I see a couple of things – incremental improvements to continue with threat representation – including IR and RF [radio frequency] enhancements,' said Fendley. However, more significant changes are on the horizon. 'The big thing that is coming is autonomy in target systems. Historically, these systems are operated with not much autonomy. There are often last-minute changes to optimise the scenario, so it's a manual intervention.

'With autonomy, the system makes its own decisions. For example, if it detects a weapon system being used against it and can make its own, real-time, very short-term decisions – measured in fractions of seconds – and decide to take evasive action, it obviously becomes a much more realistic target that is more useful to the troops or sailors training against it,' Fendley explained. This could be particularly useful in training against some of the current generation of Chinese and Russian anti-ship missiles, which follow irregular courses in an attempt to throw off defensive systems.

'The biggest [development] is the GPS-denied [scenario]. That's becoming huge because it's such an important tool from an enemy's perspective. The target needs to be able to operate in a GPS-denied environment,' Fendley added.

Electronic and kinetic attacks against GPS satellites is widely predicted to be a precursor to a future conflict between near-peer rivals. That ability to operate when the system that has been the bedrock of navigation for the past 30 years or more

is no longer available – or, at least, severely degraded – is likely to be vital.

After almost 20 years of fighting guerrilla-type opponents, over the past two or three years the US has focused sharply once again on tackling near-peer threats that have come back into the picture. 'These threats really represent the growth requirement for aerial targets because we need to develop systems to develop ourselves against these near-peer threats,' highlighted Fendley. 'That's the big push.'

Defence against aircraft, ballistic and supersonic (or even hypersonic) missiles 'are key areas that we see growing substantially in the next couple of years', he added.

At the other end of the speed spectrum, QTS has recently developed its Sniper multi-rotor target in response to the threat posed by commercial quadcopters and drones. Small drones are proliferating at an alarming rate and have the advantage – from an attacker's perspective – of being cheap, capable of modification (carrying a small but lethal explosive charge, for example) and requiring little training on the part of an operator.

The ability to cheaply mount a swarm attack was demonstrated in Syria last year when ISIS terrorists launched multiple small drones against a Russian airbase at Hmeimim, near Latakia. In just one month, Russia said that more than 40 drones were launched against Hmeimim, some with the capability of carrying a 5kg explosive charge. They also had the ability to make changes in direction and altitude, complicating the task of defence. Russia made use of Pantsir combined gun and missile anti-air systems to bring down some of the miniature UAVs.

With this rapidly evolving background, QTS last year won a potentially market toehold in the US, said Malley. 'Through our US partner, Trideum Corporation, we were awarded a place last summer on the Aerial Targets System indefinite-delivery, indefinite-quantity [programme] for the US Army Targets Management Office... That is [worth] $90 million over five years,' he told *Shephard*.

Arguably, the most sophisticated aerial targets in operation in the Western world are Boeing's QF-16 drones. Elderly marks of the Lockheed Martin F-16 are retrieved from US desert 'boneyards' and converted into remotely controlled vehicles, operated by a ground-based pilot. These retain the full capabilities of the original aircraft, with supersonic capability plus the ability to carry electronic jamming systems, as well as chaff and flares that can be deployed from eight active wing stations against incoming missiles. They can still be flown conventionally by pilots in the cockpit, for other types of training sorties if necessary.

Boeing has received orders for several batches of QF-16s in the past nine years, with 126 either converted or on order. That figure could eventually exceed 200, with examples taken from stored stocks of Block 15, 25 and 30 machines. The aircraft are not necessarily destroyed on sorties, but are used to record the miss distance of missiles. However, attrition is expected to use up the initial 126-strong fleet by around 2025. ■

The Saab WE:Are app showing an AR display with player icons and an artillery fire mission injected into the real-world view. (All photos: author)

COLLECTIVE CAPABILITIES

The capabilities of collective live training are continuing to improve as new technologies such as AR and VR are brought to bear. The realism that these can now provide for tactical engagement scenarios are increasing training effectiveness for ground forces. *Shephard* assesses the evolution of these military simulation systems and explores some of the ongoing advances being made by industry players. **By Giles Ebbutt**

Modern tactical engagement simulation systems (TESS) for live ground force training have evolved from the relatively simple laser-based systems that were first introduced in the 1980s to the current sophisticated instrumented training environments, which can replicate nearly all elements of the all-arms battle and support seamless coalition training.

Although the technology has been much improved and refined, the fundamentals of TESS remain essentially unchanged. However, recently added capabilities have helped broaden their scope.

Laser focus

A TESS consists of two major elements: the laser projector/detector and weapon effects combination; and the communications, instrumentation and tracking hardware and analysis software that provides exercise monitoring and AAR capability.

The basic principle of the laser system is that a beam is 'fired' by a transmitter fitted to the weapon, with an embedded code that carries information about the ammunition type that the laser is simulating. When the beam encounters a laser detector, it triggers a response that can read the code and identify the firer.

The main types of laser code are the Multiple Integrated Laser Engagement System (MILES) – which is the original version that was developed in the US and is still in use – and the Optical Interface Definition (OSAG). The most recent version of this, OSAG 2.0, has been further enhanced to become the NATO Urban Combat Advanced Training Technology (UCATT) standard laser code, known as

the UCATT Laser Engagement Interface Standard (ULEIS). This has now been approved by the Simulation Interoperability Standards Organization (SISO) and is recognised as NATO STANREC 4816.

The standardisation process has established agreed ammunition tables, penetration capability data and target-vulnerability guidelines. ULEIS provides an increased number of simulated ammunition types for more realistic target engagement effects. It covers engagement distance to the target, enabling lethality to be calculated according to the effective range of the ammunition. Support for indoor positioning systems where GPS is unavailable is achieved by IR diode transmitters. Laser pulse wavelengths and laser detector characteristics and geometry are standardised, and the codes are transmitted by modulating the laser pulse intervals.

A one-way laser is used for tactical engagement pairing in simple force-on-force training, while the more common two-way scanning laser simulates the ballistic trajectory and speed of a projectile and transmits impact information to detectors within its scan area, enabling a weapon-effect calculation. A return signal to the laser transmitter provides range data, which is used to simulate the impact of rounds in a gunner's sight.

The result will initiate a 'kill' or lesser effect as appropriate via a control unit on an individual harness or integrated on a vehicle, which can then disable the associated weapon. By linking each individual control unit to GPS and a comprehensive communications system, all activity in a training area can be tracked, recorded, monitored at exercise control (EXCON) in real time and analysed for subsequent AAR.

Rheinmetall's latest Legatus harness, developed for the German Army, was displayed at ITEC 2018.

Scaling down

Improvements to these fundamental elements of a TESS have largely been concentrated on the size, weight and power characteristics of transmitters and detectors, the effectiveness of the simulation of different types of armament and the flexibility of the instrumentation system.

Rheinmetall has developed a new version of the personnel harness for its Legatus system as a result of a number of contracts awarded in 2016 by the German Army to the company to upgrade the GÜZ CTC at Altmark, one of which was for 1,500 new harnesses. The latest model includes a new short-range radio operating in the 433MHz band for communications between weapon, body harness and helmet halo (the ring of detectors on the helmet), and a lighter radio for network instrumentation communications. The harness has the detectors concentrated around the upper body, which is a requirement of the German Army.

These developments complement Rheinmetall's third-generation range of laser transmitters, which includes small, medium and heavy versions for equivalent weapons. The small arms version in particular is smaller and lighter than its predecessors and has an automatic zeroing mechanism to improve the process of aligning the transmitter with the weapon sight.

The transmitters will use the ULEIS code and can accommodate two different levels of laser vest sensitivity: a high level that will record a hit if only one detector is activated, and a lower level that requires the aggregate of several activated detectors on the vest to reach a threshold before recording a hit. The German Army requires the high sensitivity as it provides localisation of the hit and fulfils a comprehensive vulnerability model. The lower sensitivity solution is less effective at longer ranges, reflecting the difficulty of accurate shooting from greater distances in these circumstances.

To provide a low-level portable CTC capability, Rheinmetall has recently developed a small-scale Legatus instrumentation system called Platoon Master. It can be integrated into the company's Gladius dismounted soldier assembly, which is the basis of the German Army's IdZ (Future Soldier) system. The self-contained instrumentation system has a manpack TETRA (Terrestrial Trunked Radio) communications base station for live training up to company level. The exercise can be monitored and controlled by a ruggedised tablet, with all activity also recorded on a notebook computer for analysis and AAR.

Moving parts

Saab has continued to refine both its individual detector harness and its BT46 vehicle system. The latest version of the harness includes a new helmet-mounted detector, which has been introduced to overcome the difficulties of using a traditional halo on a helmet with integrated fitments, particularly head-mounted displays.

The new configuration consists of a single 360° detector on the crown of the helmet, secured by straps to the rim and connected to an inductive link. This integrates it with the harness, which detects whether it is being worn and therefore providing protection, thus affecting the shot-effect assessment.

The latest generation of the BT46 vehicle system is now wireless, has an integrated radio and is controlled from a smart device app. It supports dual detection of the SISO and MILES codes. The heavy-weapon laser transmitter has been redesigned with a different giro arrangement that improves simulation fidelity when firing from a moving platform.

Ruag has developed a new COTS generic vehicle instrumentation system, which was revealed at the I/ITSEC exhibition last year. Development started in mid-2018 and will be complete by mid-2019. The company's intention is to offer a solution that could ▶

Saab's new helmet-mounted all-round detector showing the induction device on the rear.

start with a simple, flexible, low-fidelity, one-way system and then be progressively upgraded to a high-fidelity, two-way system. It is interoperable with the OEM's Gladiator TESS.

The laser detectors, which have both wired and wireless options, will provide simultaneous multi-code detection, and the system will simulate varying levels of protection that are user-adjustable. The system also includes a flashlight visible at 600m, which indicates a hit when activated via the laser sensors plus optional pyrotechnic effects such as smoke. Ruag's solution is communications-agnostic and can be integrated with a specific CTC network.

The internal vehicle interface provides ballistic data by integration with vehicle weapon systems using the DDS (Data Distribution Service) protocol. The presence of individual soldiers within the vehicle is recorded via a crew transponder unit, which provides links to the TESS harnesses to transmit the effect on the occupants of fire on the vehicle.

As TESS become more ubiquitous and are seen as a critical element in delivering realistic live training, interoperability between systems to allow the seamless integration of forces from different countries has assumed a greater importance. This is not only to facilitate multinational training events such as major coalition exercises, but also to enable one nation to use another's training facilities using its own TES equipment.

One key factor has been the standardisation of laser codes and the adoption of the ULEIS code by a growing user community. Significantly, US forces in Europe adopted ULEIS in 2016 for a vehicle TESS, and in 2018 the US Army amended its contract with Lockheed Martin (the prime contractor, in partnership with Saab) for a new VTESS to do the same.

An example of what can now be achieved due to these common standards can be seen with Exercise *Aurora,* which was held in late 2017 and involved forces from Austria, Finland, Sweden and the US. Each nation used its own TESS equipment, which was interoperable with the rest.

Tracking and support

Tracking individual personnel and vehicles and recording their actions for AAR is the core function of any instrumentation system. In general, tracking relies on GPS, but for military operations in urban terrain (MOUT) once troops are inside buildings the GPS signal will be lost. More sensitive tracking mechanisms are also required in these circumstances in order to place personnel within specific rooms in what may be a multi-storey building.

Different solutions have been developed to overcome this with varying degrees of accuracy, using both wireless and IR technology. For France's new Cerbere system, provided by a partnership of Thales and Ruag, the former company has developed a geo-localisation system for tracking players adjacent to and within buildings, which will have a claimed accuracy of less than 1m. It will also provide unambiguous positioning information when a player is passing through doors and other openings.

Meanwhile, Havelsan has developed an RFID-based system which uses tags embedded in the floor. Each trainee has an RFID receiver attached to one of their feet, which transmits the location to EXCON. The accuracy of the tracking system depends on the density of the tag layout.

At I/ITSEC 2018, Ruag revealed that it has developed a new MOUT locational system with an IR detector that can be installed in individual rooms using a magnetic attachment. Used as part of the Gladiator equipment, it detects the presence of each trainee in a specific room and passes this data to EXCON. The system has been supplied to the German Armed Forces for use in the Schnoggersburg urban training area at the GÜZ.

While the core laser/detector functionality of TES systems has continually been refined to provide a realistic experience regarding various forms of direct fire, offering similar realism for some of the combat support elements of the modern battlefield has lagged behind, particularly in the area of fire support. Solutions to plugging this gap are now emerging, using a combination of AR, VR and additional instrumentation. ▶

While it has been possible to simulate the effects of indirect fire by EXCON injecting them through the instrumentation system to vehicle and personnel harnesses, this does not exercise the whole fire support chain nor does it provide a realistic experience for troops under fire.

Cubic has therefore created the Artillery Mission Training System (AMTS), which enables artillery units to conduct proper weapons drills and participate fully in live training exercises. The initial version of the system has been developed for the 105mm L118 Light Gun under a contract to provide six concept demonstrators to the UK's Royal School of Artillery.

The AMTS is a wireless appliqué system comprising a Cubic Instrumented Measurement Unit (CIMU) mounted on the gun's barrel. The CIMU calculates the weapon's elevation and bearing, and a sensor inside the barrel detects the charge and fuse that has been loaded. The core of the system is a replica firing box, which is identical in form and fit to the real thing. It fixes the gun's location using GPS; provides ballistic computations using charge, bearing and elevation data from the other sensors; calculates the impact point and transmits this via LTE communications; and enables the weapon's firing procedures to be simulated. A loudspeaker provides sound when the gun is fired.

In terms of simulated ammunition, Cubic offers rounds with an instrumented fuse that can be adjusted with a replica fuse setter. Instrumented dummy charges are also provided to allow realistic training on charge selection and loading. The dummy shells are hollow and fit inside each other if loaded in sequence, allowing up to ten to be loaded at one time and therefore realistically replicate a fire mission.

When used in conjunction with TESS, artillery units can respond to calls for fire, with information on the impact point and ammunition type being transmitted over the instrumentation system. This means that the correct effect is applied to player systems, consequently impacting command decisions concerning fire support availability, movement, location and ammunition resupply.

The AMTS can also be used with mortars and other guns, and Cubic has been asked to produce systems for the 155mm M777 and FH70 howitzers following demonstrations in Australia and Japan. The mortar version needs only the CIMU and a communications interface, together with instrumented ammunition that detects the charge that has been set. The weapon is used with training barrels that eject the round at the bottom.

A Light Gun with the Cubic AMTS. The blue replica firing box is to the left of the breech and the CIMU is the small blue box on top of the barrel. The barrel sensor is in a muzzle plug; its antenna can be seen on the top of the barrel.

Virtual world

Another of Cubic's projects is Synthetic Wrap, which integrates live instrumented activity into a virtual version of the real world using Bohemia Interactive Simulations' Virtual Battlespace 3 (VBS3). This enables synthetic effects to be viewed in the virtual environment and also facilitates the introduction of synthetic resources, such as close air support (CAS), which otherwise might not be available for safety reasons.

Using Synthetic Wrap, the indirect fire effects that are generated either from EXCON or, in future, using AMTS, can be viewed by a forward observer using an emulated device integrated into the instrumentation system, which shows a virtual copy of the real world. The fall of shot is shown in the virtual world and can be corrected. The observer can use the device to conduct complete fire missions including locating a target with a laser rangefinder geo-referenced in the virtual environment to the identical position in the real world.

Cubic has developed an emulated version of the in-service Safran Vectronics Moskito observation and laser rangefinding device, although (unlike the real thing) this is tethered to a separate communications device. An un-tethered, wireless version of the Safran Vector has been manufactured for Australia.

Synthetic Wrap can be used to support ground-based air defence (GBAD) training

by generating synthetic aircraft targets for engagement by weapons or converting a live target into a different platform, such as using a small instrumented UAS to emulate a helicopter. Utilising the same real/virtual-world integration as with the Moskito device, Cubic has developed an imitation of the Starstreak GBAD missile aiming unit, allowing air defence units to engage synthetic air targets. If the engagement is unsuccessful, the effects of hostile CAS on specific targets can be injected into the TESS.

Taking such realism one step further, the device has also demonstrated the engagement of real aircraft equipped with Cubic's Air Combat Manoeuvring Instrumentation (ACMI) system. Through integration with the ACMI, the real aircraft can be engaged with a synthetic missile – the pilot is aware of the engagement and can take appropriate defensive measures. The system is in use with the British Army at Salisbury Plain Training Area, the British Army Training Unit at Suffield and in Kenya in both manpack and self-propelled Starstreak versions. The Australian Army has asked Cubic to develop a version for its RBS70 weapon system.

The UK is now looking to develop the concept further and issued an invitation to tender (ITT) in March 2019 for Project SCOPIC 2, which will 'evolve and expand the current SW [Synthetic Wrap] capability', according to the MoD. The contract, worth between £5 million and £25 million ($6.5 million to $32.5 million), will run for three years with four option years. The ITT requires the new project to be able to integrate with the existing UK TES capability provided by both Cubic and Saab. It also states: 'There must be scope to integrate additional instrumented capabilities should they be developed and delivered during the life of the contract. SCOPIC must have the capacity to be interoperable with… the TES systems used by NATO allies.'

We visualise

The enduring gap in TESS remains the lack of visualisation of effects for the dismounted player, who will only see or hear indirect fire where this is provided by prepositioned battlefield effects simulators. The solution to this is the use of AR, through devices such as the Microsoft Hololens. However, such technology is still in its infancy – it has a restricted FOV, and it does not yet provide a realistic overlay to the environment. However, the software has considerable potential.

Saab has used AR in one of its new 'WE:' apps, which the company has developed for its TESS capability. The first of these, WE:Go, was introduced in 2016 to provide an individualised AAR capability, offering individual performance data such as distance covered, shots fired, accuracy and survivability on a personal device through Wi-Fi streaming. Recorded video is also available.

WE:Go was followed in 2017 by WE:Are. This provides an additional capability for observer/controllers (O/Cs) monitoring live instrumented exercises while accompanying troops on the ground. It uses AR to provide real-time visualisation of instrumented personnel, targets and engagements as an alternative to a map-based view, including the representation of indirect fire. An O/C can take a snapshot of an event in AR for use in hot debriefs as well as replaying the map-based view. The WE:Are app can also be used by an O/C to inject events direct from the tablet.

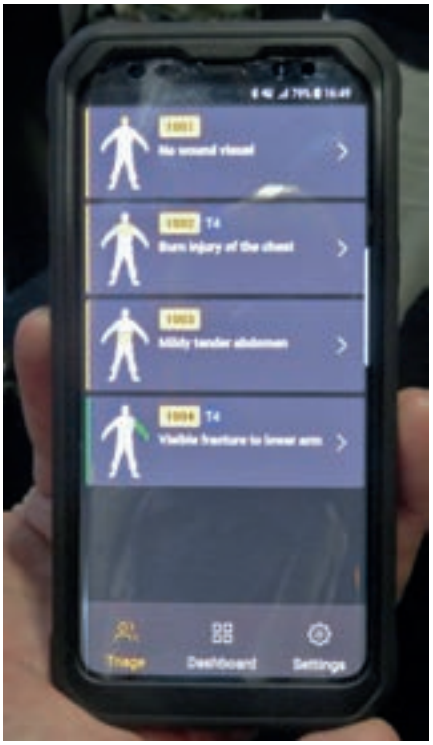
The most recent addition to the WE: family is WE:Treat, a medical treatment simulator to support medical personnel training. This has been developed in response to requests from existing Saab customers. The effectiveness of battlefield medical training has developed dramatically the last decade, with lifelike wounded mannequins and role-players providing highly realistic training scenarios, but these require planning and pre-arrangement. Incorporating medical treatment 'on the fly' during force-on-force training is less easy: WE:Treat is an effort to overcome this.

The application is based on a medical treatment database with software that will determine the nature and seriousness of a soldier's wound from the hit location and ammunition type, and identify the treatment required. When a player is 'hit', medical personnel can go through the triage and assessment process according to the directions on the device. The latter is based on a standard sequence such as CABCDE (catastrophic haemorrhage, airway, breathing, circulation, disability, exposure), which can be adapted to reflect the user's standard practice.

The app links to the wounded player's harness and receives the details of the injury. Medical personnel can then use the software to conduct the triage and assessment, receiving feedback on the casualty response at each stage of the sequence. The actions taken are passed to EXCON via the instrumentation communications for subsequent use in AAR. This includes the triage decisions taken and a summary of examinations and treatments performed by each medic and the time these have taken, including assessment against the 'platinum ten minutes' and 'golden hour' – the vital periods immediately after wounding when life-saving treatment may be critical.

The treatment provided is stored via the app. This enables previous treatment and its effect to be incorporated into the responses given to the app as the casualty progresses back through the evacuation chain and is 'treated' by other personnel using the software. WE:Treat also tracks the speed of transport through the casualty evacuation chain for subsequent analysis. ■

Saab's WE:Treat app hosted on a smartphone-like device showing the user interface and personnel injuries.



Instructors can inject over 150 faults on the AMWLT. (Photo: author)

SIMULATING SEAHAWKS

The Royal Australian Navy has made considerable investment in its MH-60R Seahawk training facilities for both aircrew and maintenance technicians. *Shephard* looks at the variety of equipment being utilised in the HQ of the service's Fleet Air Arm.

By Trevor Nash

The Royal Australian Navy (RAN) operates a fleet of 24 Sikorsky MH-60R Seahawk Maritime Combat Helicopters from HMAS *Albatross*, the first of which arrived in October 2014. The aircraft were procured under Australia's Project Air 9000 Phase 8 programme, the first FMS MH-60R procurement.

The 'Romeo' has three primary missions in RAN service: undersea warfare, surface warfare and EW. Secondary roles include ISR, medevac, SAR and vertical replenishment. The platform is clearly very flexible and forms the backbone of the RAN's Fleet Air Arm (FAA).

Unlike the USN, which operates over 250 MH-60Rs, each with two pilots, a tactical communications officer and a sensor operator, the RAN FAA adopts a different crewing policy, opting for a single pilot, a tactical coordinator (also known as a Maritime Aviation Warfare Officer) who occupies the left-hand seat and a sensor operator in the cabin.

Base camp

HMAS *Albatross*, a short drive from Nowra, New South Wales, is the HQ of the RAN FAA. It is home to 725 and 816 Squadrons that operate the MH-60R, 808 Squadron operating the MRH90 Taipan and 723 Squadron with the EC-135T2.

Looking at the MH-60R operations at Nowra, 725 Squadron undertakes the training for MH-60R aircrew and

maintenance technicians, while 816 Squadron is the operational unit. With 24 aircraft now in service with both squadrons, the latter has the ability to embark eight flights to sea at any one time on board Adelaide-class frigates (FFGs), *Perth*-class destroyers (DDGs) or *Canberra*-class Landing Helicopter Dock vessels.

'Embarked flights are what we are all about, and ship captains all want a helicopter,' explained Capt Grant O'Loughlan, deputy commander of the RAN FAA. 'The normal MH-60R embarked team comprises two pilots, two sensor operators, two tactical coordinators and 12 technicians and aircraft handlers.'

Like most elements of the Australian Defence Force's (ADF's) training capability, the MH-90R training facilities provided at Nowra in the Seahawk Simulation & Warfare Centre's Maintenance and Aircrew Training Facility are world-leading.

'We had the benefit of designing the Romeo training facility from the ground up,' said Cdr Stan Buckham, commanding officer at 725 Squadron. 'This is an outstanding facility and is a result of many years of knowledge and thinking, and drawing on past experience. What we need are highly trained aircrew and maintainers to get the most out of the aircraft, and this facility produces them.'

Buckham described the training facilities for the Romeo's predecessor, the S-70B Seahawk, as 'not really thought out'. The squadrons were located away from the simulators and classrooms while other training aids were also dispersed. 'The current solution is totally integrated and therefore far more capable,' he confirmed.

When Australia selected the Romeo, CAE was part of Team Seahawk, having cut its teeth on numerous MH-60R and MH-60S training devices for the USN. In 2012, the company, supported by its major sub-contractor JF Taylor, was contracted by the USN to build a suite of training devices and simulators for the RAN. Today, CAE provides on-site training support services to the FAA for the MH-60R.

'These support services include the maintenance of eight training devices, instructor support services as well as courseware revision and maintenance,' explained Daniel Stuhr, CAE's site manager at HMAS *Albatross*. 'We have six instructors here, and they have all served either with the US Navy or RAN.'

Tools of the trade

The jewel in the crown of the synthetic training equipment (STE) used by the MH-60R crews are two Tactical Operational Flight Trainers (TOFT). Each TOFT comprises a full mission simulator (FMS) and a weapons tactics trainer (WTT), the latter for training rear crew sensor operators. Both devices can be used discretely or networked.

The WTT has a 6DoF electric motion platform and a 220x60° FOV Medallion 6000 image generator visual display. It is fitted with five Barco SIM-7QP LCoS projectors.

'We are very proud of the TOFTs, as they were the first MH-60R FMS devices to be certificated to Level D standards – the highest qualification for a flight simulator,' said Stuhr. TOFT One arrived in March 2015 and TOFT Two in October 2017.

'At the moment, we are conducting around 70% of our flight training in the simulator and 30% in the aircraft for new pilots on a 12-month type course,' O'Loughlan told *Shephard*. 'This is the same ratio for experienced pilots coming onto the Romeo, but their course lasts for six months.'

In terms of operational training, O'Loughlan offered: 'The RAN wants to do more simulation, especially networking with the US Navy for joint or coalition exercises.' This ability to work with allies was mirrored in 2018 when 816 Squadron sent two aircraft to participate in Exercise *Joint Warrior*, held in Scotland. 'We'd like to go to Scotland every year, as it provides valuable training for us,' said O'Loughlan.

Pilots are categorised from D through A depending on their level of expertise. Each year, 725 Squadron graduates ten pilots, ten tactical coordinators and ten sensor ▶

The FMS element of the TOFT features the Medallion 6000 image generator and Barco SIM7QP projectors. (Photo: CAE)

operators. Around 60% of the training time at 725 is focused on initial training, with the remainder dedicated to continuation and work-up training for flights that are about to embark.

In addition to the TOFTs, other STE includes an avionics maintenance weapons load trainer (AMWLT), a composite maintenance trainer (CMT), a rear crew trainer (RCT) and the Enhanced Landing Safety Officer Part-Task Trainer (ELSOPTT).

Tactical coordinators and sensor operators spend a lot of time in the AMWLT, which is described as a simulator and emulator. Delivered in March 2015, this device is also used by avionics technicians as well as weapons' specialists for loading and unloading ordnance.

Like the ELSOPTT, the RCT has been built by Anna Bay, New South Wales-based Virtual Simulation Systems and features the Titan Vanguard visual system viewed through a head-mounted display. The device is used primarily for gunnery training for the GAU-21 12.7mm and MAG 58 7.62mm door-mounted weapons and also provides hoist and underslung load training.

As well as the STE provided through the FMS contract, CAE also acquired two devices that were in situ from the aircraft the Romeo replaced, the SH-70B. The so-called 'Bromeo' (the B coming from the SH-70 Bravo nomenclature) is an airframe trainer. The other device, the Operator Machine Interface Assistant/Airborne Low Frequency Sonar Trainer Simulator, is for practising operating the aircraft's AN/AQS-22 dipping sonar system and is used prior to training in the TOFT.

The IOS for the ELSOPTT. (Photo: author)

Enhancing experience

Although comprehensive, the current STE is being enhanced with the addition of an automated flight control system trainer. This device is due to be delivered in early 2020. The two TOFTs are also being modernised through a funded engineering change proposal (ECP) to improve the visual database and model library, convert the devices to Windows 10 and make the devices capable of training through a distributed network. The latter will 'facilitate us training with other ADF and US Navy platform simulators', said O'Loughlan.

As well as the TOFTs, configuration updates that match changes to the aircraft with the STE are also taking place on the CMT and AMWLT through the same funded ECP.

In addition, the ELSOPTT is being upgraded. The device replicates the landing signal officer (LSO) position on the deck of the FFG and DDG. On the approach to land, the LSO communicates with the pilot regarding landing conditions and the quality of the approach. The LSO views the outside world through a head-mounted display.

Ships do not have a permanent LSO, as this task is undertaken by non-flying aircrew from the embarked flight. On touching down in rough seas, the aircraft locks into the Recovery Assist, Secure & Traverse system that holds the aircraft on the deck.

The RAN DDG ships use the modern Aircraft Ship Integrated Secure & Traverse (ASIST) system from Curtiss-Wright Indal Technologies, and the ELSOPTT is shortly to be fitted with this upgrade. Featuring the Calytrix Technologies Titan Vanguard visual system, the trainer is built by Australian company Virtual Simulation Systems.

Pilots joining the MH-60R fleet are relatively experienced, 'with around 500 hours in their log books. They will have flown the PC-9, the EC-135T2 and will have spent time with 808 [Squadron] flying the MRH-90,' said Buckham.

Pilots would also have had experience flying the CT-4B at the ADF's Basic Flying Training School at Tamworth. With the arrival of the PC-21, the school has now closed, and pilots start their flying training on the PC-21 at East Sale, Victoria, and Pearce, Western Australia, as part of Project Air 5428, which is being managed by Lockheed Martin and its Team 21 members, Pilatus and Hawker Pacific.

The Australian Army and RAN share the MRH-90 Taipan fleet, and 808 Squadron provides an ideal opportunity for pilots moving on to the Romeo to gain experience and to 'hold' prior to the next MH-60R course starting. Experience directly related to the type is also gained with 723 Squadron, flying the EC135T2.

The latter squadron is part of the ADF's Helicopter Aircrew Training System (HATS) – Project Air 5428 – that is operated by a Boeing-Thales team. During their time with 723, pilots would have undertaken deck landings at sea on the MV *Sycamore* multirole aviation training vessel, which entered service in 2018. Built by Damen Shipyards, the vessel serves as a training platform for army and navy personnel involved in maritime operations and was procured as part of the HATS programme.

Technical know-how

The remainder of the STE devices at HMAS *Albatross* are used for maintenance technician training. Recently qualified technicians bound for the MH-60R fleet arrive at Nowra after completing a 14-month course at the RAAF School

of Technical Training (RAAFSTT), RAAF Base Wagga, located at Wagga Wagga, New South Wales. This professional technician course is proceeded by 11 weeks at the RAN Recruit School for basic military training.

RAAFSTT houses around 1,000 trainees and returning students every year and is responsible for the delivery of over 25 different technical courses. Graduates of the school are taught how to maintain aircraft, service aviation components, armament systems, life support equipment and other technical equipment, in addition to managing maintenance processes at all levels.

The RAN has two aviation technical trades: Aviation Technicians Avionics (ATVs) are responsible for maintaining communications, navigation, sensors, ASW equipment electrical power generation and weapon systems; while the Aviation Technicians Aircraft (ATAs) focus on engine and power trains, hydraulics, environmental equipment, flight control devices, aircraft structures, ground support equipment and landing gear systems.

When personnel report to the Training Authority – Aviation at HMAS *Albatross* after completing their course at RAAFSTT, they all undertake a common training course. This covers aviation technical administration, RAN maintenance documentation, explosive ordnance and confined-space entry procedures. After this initial course, technicians destined for the MRH-90 Taipan in 808 Squadron move to the Army Aviation Training Centre in Oakey, Queensland, for their type-specific training, and those for the MH-60R stay at Nowra.

The MH-60R ATV course lasts for 23 weeks and the ATA course for 33 weeks. Known as Equipment Application Courses (EACs), both make use of computer-based instruction and self-paced learning as well as the range of STE that is found in the Seahawk Simulation & Warfare Centre's Maintenance and Aircrew Training Facility.

Cdr Stan Buckham, commanding officer of 725 Squadron, RAN. (Photo: author)

The classroom element is conducted in eight maintenance training classrooms.

Since 2015, 356 aviation technicians have undergone courses to qualify on the MH-60R. In addition to the ATV courses and ATA EACs, 725 Squadron provides bridging courses from other aircraft types such as the S-70B and MRH90.

'Compared to the S-70B, ATV and ATA training has moved on from the classroom- and instructor-driven syllabus that used limited training aids,' said Lt Donovan, a maintenance instructor at Nowra. 'We still use classroom and instructor components but it is much more practically based. The simulators provide the opportunity to remove and install components and to carry out much more fault diagnosis, particularly for avionic systems. The result is that technicians complete their training to a higher level of competency and in a shorter time than was the case with the S-70B.'

In terms of the STE on offer to the ATA and ATV students, the Bromeo is used to teach the removal of major components such as rotor heads or landing gear, as well as inspections and the replacement of aircraft fluids and pneumatic gas systems.

The CMT is a troubleshooting device primarily used for hydraulic and avionic fault finding. The instructor can insert over 100 faults in the device. The AMWLT can create over 150 instructor-initiated faults and provides additional training for ATV students. It also serves as a weapons loading trainer. Typical ordnance carried on the Romeo includes the Mk 54 torpedo and AGM-114N Hellfire missile, and in the future, the Advanced Precision Kill Weapon System, which is a conversion of the Hydra 70 rocket system with an added laser guidance kit.

The Seahawk Simulation & Warfare Centre's Maintenance and Aircrew Training Facility is clearly well-equipped and highlights the benefits of industry (in this case CAE) working together with the military to generate professional and well-motivated aircrew and maintenance technicians.

In terms of population, Australia is a small country, but there is no doubt that the ADF punches well above its weight when it comes to investing in T&S for its service personnel. One need look no further than HMAS *Albatross* to see evidence of this investment and commitment to training. ■

Pre-flight checks in a CH-148 Cyclone flight simulator at 12 Wing, CFB Shearwater. (Photo: Canadian Forces)

GUIDED EXPERIENCES

As the fidelity of virtual simulation continues to improve, more rotary-wing training is now being conducted out of the aircraft and on the ground. With industry providing increasingly comprehensive services, this trend seems to be the way forward for armed forces worldwide.

By Dr Joetey Attariwala

Military helicopter pilot training, like all flight training, has evolved to include a significant amount of time in a simulator. Although simulation alone is not the panacea – since there is no comparison to the experience of live flying – it is favourable compared to the associated costs of flying and maintaining real aircraft.

With that reality in mind, simulation used to train military helicopter pilots is advancing, such as in the replication of stressful situations like operating in brownout or whiteout conditions, which could be quite dangerous if experienced by a pilot for the first time in an actual helicopter.

The realism of cost-effective and robust training devices is of paramount importance, but it is rare for RfP requirements to provide an exacting definition of the simulator – the missions themselves usually much better define what is really needed for training value. In fact, recent years have seen an increased uptake in the use of simulation to train operational helicopter crews in complex tactical scenarios.

Turnkey training

A prime example of the translation of needs into implementation is the CH-53E aerodynamic model that Aero Simulation (ASI) will be delivering to the USMC in 2019.

Vlad Argintaru, a visual engineer at ASI, told *Shephard*: 'one of the most critical areas of flight for a rotary-wing aircraft is in close proximity to the ground or water during take-off, landing and just hovering. The downwash of the rotors pushes particulates, sea spray, dust, dirt or snow into the air, obscuring the view of the pilot during this most critical moment of flight. ASI has implemented a true-particle/physics-based volumetric model representing the detachment and recirculation of the actual material particles from the 3D texel-based visual/sensor database.'

Helicopter OEMs, with an eye on increasing their profits, have carved out entire lines of business focused on training. For example, Sikorsky is partnered with Lockheed Martin's Training, Logistics & Sustainment business, which today manages the Royal Canadian Air Force (RCAF) CH-148 Cyclone training contract.

In addition, manufacturers often partner with Training System Integrators like CAE, FlightSafety, TRU Simulation + Training and others to develop training solutions.

Randy Gawenda, business development manager at Frasca International, shared his thoughts on military helicopter pilot training today: 'Aircraft and instructors are short in supply and are the two largest costs of the programme, so anything that can help reduce utilisation of those two assets while performing quality training without negative transfer will likely see an increase in implementation. We are starting to see customers understand how to use a broader range of training tools to optimise their training pipeline.'

Modern helicopter schoolhouse training is exemplified by projects such as CAE's Medium Support Helicopter Aircrew Training Facility (MSHATF) at RAF Benson in the UK. This is one of the first programmes of its kind where a military customer pays 'by the hour' for a turnkey training service. CAE was responsible for the design, construction and financing of the facility, which opened in 1999. The company owns and operates MSHATF under a 40-year private finance initiative (PFI) contract.

The programme includes academic classroom training and simulator training delivered by ex-military instructors to the UK's Joint Helicopter Command, which includes both RAF and RN helicopter crews. This instruction is carried out by CAE's partner, Serco. MSHATF is equipped with six CAE-built full-mission simulators configured for Chinook (three), Merlin (two) and Puma (one) helicopters. Under the terms of the PFI contract, CAE also has the ability to provide turnkey training to third-party users that have included the air forces of Canada (CH-149 Cormorant crews), Denmark, the Netherlands and Singapore.

Capable hands

Another example of turnkey training provision is the RCAF's Contracted Flying Training and Support (CFTS) centre in Southport, Manitoba. The CFTS contract was awarded in 2005 to Allied Wings, a subsidiary of Canadian-owned and -operated KF Aerospace. This marked the introduction of a fully integrated and advanced flight training programme that utilised the latest in aircraft and simulation technologies (see *MTSN* Nov/Dec 2018 p42-46).

Allied Wings is responsible for all services including administration, aircraft, airfield and infrastructure, so the RCAF can focus on the training standards and instruction. This relationship has enabled heightened production and focused training.

Following fixed-wing training on the Grob 120A and possibly the CT-156, training then shifts to the CH-139 Jet Ranger and Bell 412CF Outlaw helicopters to prepare pilots for their operational careers. 'The CH-139 is utilised as a basic rotary-wing trainer to instil the fundamentals of helicopter operations. This training involves a great deal of skill and risk on the part of the instructor and the aircraft, and has effectively remained unaltered for the past 35 years,' said Peter Fedak, CFTS site manager from KF Aerospace Defence Programs.

'To advance this training, the RCAF has introduced into the programme a state-of-the-art Level 7 FTD with a 6DoF motion base and the latest in image generation, which is sourced from Frasca International. Conducting a portion of the basic and highest-risk activities of this training in a safe and controlled environment will enable rapid repetition of sequences free from the random and often adverse effects of weather,' he continued.

Over 50% of the CFTS programme is conducted in the synthetic environment using one of the two advanced flight simulation devices. 'With the current programme now past the midpoint of execution, there are many exciting advancements proposed by KF Aerospace to meet the needs of the future,' confirmed Fedak. 'Full glass cockpits, ADS-B technologies, LPV [localizer performance with vertical guidance] approaches and further advances in low-cost simulation devices are all being investigated as options for the RCAF to employ in its training programmes. Combine these efforts with the Future Aircrew Training preparatory work being done by SkyAlyne, a corporation owned 50/50 by KF and CAE, and the RCAF is in capable Canadian hands for the foreseeable future.'

Asked about the CFTS FTD, Gawenda said: 'We recently qualified a Level 7 CH-139 for use in KF Aero's Southport training facility, which means that Frasca is providing the simulator for all initial RCAF helicopter training. It's one of only two Level 7 helicopter FTDs in Canada, both of which are Frasca's. We are also currently under a subcontract to provide ten new TH-57 FTDs to FlightSafety Services Corporation, which is the prime for the US Navy TH-57 Aviation Training Services contract.

'We just delivered the first Level 6 FTD Ready For Training [RFT] on time. We also just completed successful factory acceptance on the first Level 7 TH-57 FTD on schedule, and that will be delivered at the end of May. At the end, Frasca will have delivered all ten FTDs RFT to Whiting Naval Air Station in 22 months after contract ►

Inzpire provides instructor pilots to train British Army and RN Lynx Wildcat pilots. (Photo: UK MoD)

award,' Gawenda explained. Both devices have short-stroke electric motion platforms.

Frasca also recently delivered a reconfigurable Bell 212/412 to the Mexican Air Force under a subcontract to Bell via an FMS case from the US Program Executive Office for Simulation, Training and Instrumentation. This programme required night vision goggle training as well as ballistics simulation for specific mission training for the air force.

Assisted learning

The USN TH-57 programme is interesting because although the service is looking for a TH-57 replacement, current investment is designed to sustain training for the type until new aircraft enter service. In 2018, FlightSafety was selected as the prime contractor for TH-57 Aircrew Training Services programme. The company now delivers instruction and contractor logistics support, and manages the replacement of the current TH-57 instrument flight trainers with a variety of FTDs, as described earlier by Gawenda.

'All of us with FlightSafety are proud to be selected as the prime contractor for the TH-57 programme. This clearly demonstrate our ability and commitment to provide the highest-quality products and training services,' said Hector Zarate, president of FlightSafety Services. 'We sincerely appreciate the support that Frasca International and Aechelon Technology [which is supplying image generators] are providing for the TH-57 contract.'

The contract includes three Level 6 FTDs and seven Level 7 devices. The former will include a full TH-57 cockpit representation with a 180x40° FOV visual system, while the latter will have a 240x70° FOV visual system. The first Level 6 device was delivered at the end of February 2019.

The flight training will be carried out for the USCG, USMC and USN by Training Wing 5 at NAS Whiting Field, as well as for students from Algeria, Denmark, France, Italy, Mexico, Saudi Arabia and Spain. It is delivered by 35 flight instructors who are all former naval aviators.

While the military desires a standardised, proficient aviator at the end of training, not everyone learns in the same fashion. This led Frasca to develop SimAssist through an internal R&D project, which is now included in the Navy's TH-57 programme. SimAssist helps provide a guided experience for self-paced learning. 'If you think of it as an adjustable stability augmentation system, that is really the concept, but while the aircraft uses hardware and components, SimAssist is a software programme that can manipulate either the flight model itself, the flight controls or both, depending on the level of assistance the system detects,' said Gawenda.

'It can help new students begin to learn the muscle memory needed for hovering as it keeps them "in the box" so to speak with their control movements and input strategies,' he continued. 'It may also help balance out the cognitive load for new tasks, as more brain power is applied to the new task and thus performance may drop. This eventually comes back up on its own through more training, but the system can help accelerate the learning curve based on the individual's strengths and weaknesses.'

This leap in technology will allow the USN to optimise its training curriculum and allow training to be conducted in ways that were not previously possible. It also allows a customer to utilise costly training tools more efficiently. 'The ability to start training in the sim and have it transfer over to the aircraft for initial-entry rotary-wing training is unusual at this level. Not only are we seeing this with the US Navy, but the way KF Aero is adopting our CH-139 FTD is much the same,' explained Gawenda.

'The phrase "train in the simulator, and validate in the aircraft" is common now in both groups, and we are seeing that with how the FTD is implemented in the curriculum. The fidelity and accuracy of the simulation is able to have more tasks pushed to the synthetic environment without negative transfer of training or sacrificing the tasks and levels of learning that can be accomplished in the simulator now,' he said.

Price in mind

Another key factor is cost. Frasca's Level 7 FTD with the Frasca Motion Cueing System costs around 50-65% of a typical FFS or operational flight trainer, yet is extremely accurate and true to the real platform.

'The US Navy and RCAF understood this equation, and were very deliberate in the training tools they were researching. They were smart shoppers and looked at the very latest in technology, and the Frasca [offering] provided a proven, readily available solution

The Frasca Bell 206 FTD at CFTS Southport. (Photo: Frasca International)

RCAF CH-147F simulators are provided by CAE. This image is created by the company's Medallion 6000 image generator. (Image: CAE)

that was low-risk as we had already fielded the system in the commercial world, so while we have to make modifications and some customisation for every customer of ours, it was a commercial product that could be readily adjusted to military customer requirements,' said Gawenda.

TRU Simulation + Training is taking a similar approach with its military helicopter pilot training. The company is currently focused on supporting several platforms including the AH-1Z, UH-1Y and the V-280 Valor – Bell's entry into the US Army's FVL programme. 'For the V-280, we have developed (with Bell) three simulators used for demonstrating the V-280's capabilities, especially speed and agility. The demonstrator is a traditional fixed-base simulator with a high-fidelity cockpit, control loading and domed visual system,' said John Hayward, senior VP and general manager of TRU's Government division.

'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. 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,' he added.

According to TRU, this approach allows more advanced students to learn, demonstrate their knowledge and competency and move on, while conversely providing students who may be struggling with knowledge or a skill more time to learn and practise. 'We are seeing, through our R&D 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.

Classes in session

However, it is not just about new technologies, as increasing amounts of training are being provided by industry.

The CH-148 Cyclone schoolhouse is utilised by 406 Maritime Operational Training Squadron located at 12 Wing CFB Shearwater. Sikorsky and principal subcontractor L3 MAS custom designed and built the 18,580m² aircrew and maintainer schoolhouse as part of the Canadian Maritime Helicopter Program (CMHP). The three-story facility includes classrooms, briefing rooms, training aids and flight and mission simulators.

Sikorsky is the prime contractor for the CMHP, and it partnered with Lockheed Martin for the management and implementation of the aircrew and maintenance training portion. After completing the training of initial cadres, CMHP is now conducting conversion training through a five-month course that uses classrooms, two Collins Aerospace Level D simulators and flight training, which runs 16 hours per day for five days each week. This training consists of two classes of six pilots each, and is expected to end in July 2020. Type training for new Cyclone pilots will begin in 2021.

Mike Tinio is the CH-148 Cyclone training programme manager at Lockheed Martin Training, Logistics and Sustainment. He offered: 'In order to provide the highest fidelity and quality of training... we used wherever possible actual aircraft systems and parts in the simulators to accurately replicate the aircraft flight deck. Each flight simulator uses the aircraft's operational flight programme and instrumented data to ensure the aircrew training device behaviour matches Cyclone aircraft to the highest degree possible.'

Currently, 75% of each pilot's training consists of classroom, computer-based training and simulator time, with the ►

CFTS CH-139 Jet Rangers operated by Allied Wings, a subsidiary of KF Aerospace. (Photo: author)

remaining 25% (approximately 25h) being conducted in the aircraft. According to Lockheed Martin, there is a shift toward more training in the simulator and classroom, and less on the aircraft. 'Current budget pressures in both commercial and military training services and advancements in available technology naturally shifts aircrew and maintenance training to more simulation versus use of actual aircraft and equipment. This approach drives training efficiency and reduces training costs,' explained Tinio.

Dynamic simulation

In the UK, Lockheed Martin is delivering Chinook HC6 training for pilots and air loadmasters at the new Chinook Mk6 Synthetic Training System (STS) facility at RAF Odiham. The role of the STS is to provide tactical, whole-crew, pre-deployment and currency training to already qualified crews from all three frontline Chinook squadrons.

The STS will supply up to 4,000h of training each year for use by the RAF Chinook Force. The facility consists of a turnkey training centre with classroom, mission planning, brief/debrief facilities and simulation halls. The primary training devices are two flight deck devices (FDDs) and one rear cabin device (RCD) replicating the cockpit and rear cabin of a Chinook Mk6 respectively. These devices can be networked together to deliver individual, team and collective training for the UK Chinook Force.

The STS supports full mission rehearsal during day/night across the FDD and RCD with the use of night vision goggles and a night vision imaging system. Simulation is supported through the Sage visual and database system.

Also in the UK, Inzpire has been delivering live helicopter flying training to the British Army Air Corps' Apache AH1 for seven years and more recently on the Lynx Wildcat helicopter. In the synthetic environment, the company's Helicopter Services Division is providing instructional support on the Chinook Mk6 simulator and to the European Defence Agency Helicopter Programme. Furthermore, Inzpire has been in the business of collective synthetic training for over ten years as the 'white force' at the Air Battlespace Management Centre at RAF Waddington.

In a similar fashion, CAE recently provided training support to RCAF CH-147F Chinook and CH-146 Griffon helicopter crews that were conducting training prior to deploying for the UN MINUSMA (Multidimensional Integrated Stabilization Mission in Mali). Aircrews from 450 Tactical Helicopter Squadron at Petawawa and from 408 Tactical Helicopter Squadron in Edmonton prepared for the mission in CAE-built full-mission simulators.

CAE developed a high-fidelity virtual database of Mali based on the Open Geospatial Consortium Common Database. Instructors from the company then worked closely with RCAF personnel to create lesson plans so aircrews could rehearse a range of missions, including aeromedical evacuation, in the virtual world.

'We knew Task Force Mali would be a very high-tempo mission requiring our aircrews to be prepared and ready at a moment's notice,' said Col Travis Morehen, commander of 1 Wing, RCAF. 'Simulation-based training is an invaluable tool in helping familiarise our aircrews with the operational environment and giving them the ability to practise and rehearse a variety of mission scenarios before actually having to perform these life-saving missions for real.'

Discussing this training, Joe Armstrong, VP and general manager at CAE Canada, told *Shephard*: 'Simulation is an ideal tool for pre-deployment operation and mission rehearsal training because it gives aircrews the opportunity to safely and cost-effectively prepare for real-world operations in a virtual environment... CAE is the RCAF's training partner on all the aircraft platforms involved in Task Force Mali, and we bring a great deal of experience and expertise as a training systems integrator in being able to help the RCAF leverage its simulation-based training enterprise to support its operational missions.'

In mid-2018, CAE launched the CAE 700MR Series FTD, a next-generation device designed specifically for military helicopter flight and mission training. During internal R&D initiatives as well as customer research, the OEM identified a market requirement for high-end, fixed-base helicopter FTDs. The 700MR Series is based on the CAE 3000MR Series full-mission helicopter simulator, but in a fixed-base platform with dynamic seats for vibration and motion cueing. Among other features, the 700MR includes a 240x88° display that is driven by the company's Medallion-6000XR image generator.

Outlined here have been just a few of the countless new technologies that are being employed to train modern military helicopter pilots. These are more often than not encompassed within major training schoolhouses, something which is intended to satisfy the needs for delivering training in an efficient and cost-effective manner. ■

Like many companies, VT MÄK is offering a one-world visual database to its customers. (Image: VT MÄK)

ONE WORLD VIEW

The relative proliferation of high-quality source data, more powerful rendering engines and improved displays means that the visual fidelity of simulation systems is continuing to improve. The question is: What's next on the horizon?

By Peter Matthews

One key trend that has emerged over the past decade in the military T&S sphere is that training is increasingly being conducted in the virtual domain. As well as being obviously cheaper than operating the real platform, virtual training is safer, more environmentally acceptable and more repeatable.

Another influencing factor is the realism provided by modern virtual simulators and the fidelity of the visual database in particular. More detailed and immersive databases driven by faster image processing and more resolute projection display systems are more able to 'suspend disbelief' and provide increased realism for the trainee.

Flexible service

Other trends that are now emerging in the T&S sector centre around how training is delivered. This was previously always viewed as a linear process where, in the case of pilots for example, initial training was conducted in a classroom, followed by the utilisation of part-task trainer before moving onto the full flight simulator and then to the aircraft itself.

This training was very much hardware-based, and that technology, it was argued, had to match the actual platform as closely as possible in order to prevent 'negative training'. A number of nuanced changes have recently taken place, suggesting that perhaps the fear of negative training has been overplayed. Instead of emphasis on exact replication of the physical components of the real platform, there is now a move towards a more generic approach, whereby simulation software is seen as more important than the simulator's hardware.

Once the metal has been bent to make a simulator represent a particular platform, that's it, but a more flexible software-centric approach allows that device to be reconfigured to represent a variety of aircraft, albeit by replacing some hardware modules such as a throttle quadrant or control column.

The result of this shifting paradigm is that a number of simulator manufacturers are beginning to field reconfigurable training devices that highlight the capability of Modelling & Simulation as a Service (MSaaS). This was apparent at I/ITSEC 2018 in Orlando, where Boeing, FlightSafety International, L3 Link and Lockheed Martin were all displaying such devices. ▶

> ***MSaaS offers an approach to coherently manage and optimise delivery of modelling and simulation.***

In essence, MSaaS provides an environment through which software can be delivered as and when required from the cloud. By offering the potential to create a common training environment, this approach is being taken very seriously by NATO, whose Modelling and Simulation Group has established a study group to investigate the advantages that MSaaS can provide.

'MSaaS offers an approach to coherently manage and optimise delivery of [modelling and simulation] across the defence enterprise to benefit all users,' explained Jon Lloyd, principal research engineer at the UK's Defence Science and Technology Laboratory.

Common knowledge

With MSaaS leading the way in emphasising software in the delivery of simulation, what about the visual database? Imaging would appear to be the ideal candidate for MSaaS exploitation, as historical efforts to re-use visual databases have always been problematic largely due to proprietary interests, poorly defined common standards and protocols and the whole issue of legacy databases not being compliant with more modern technologies.

Discussion on this topic by the more mature simulation users around the world often turns to programmes such as STE (Synthetic Training Environment) and SCARS (Simulator Common Architecture Requirements and Standards) in the US, JP9711 in Australia and DOTC(A) (Defence Operational Training Capability – Air) in the UK, specifically in the networking of virtual simulators. Will this ever happen considering the lack of common visual database standards and the plethora of legacy systems? Indeed, will there ever be a common visual database standard?

'It is certainly possible,' conceded Richard Rybacki, chief technology officer and co-founder at MetaVR. 'However, given the current political climate, I would think no – there are just too many different agencies and governments involved. We cannot get a standardised system here in the US alone.'

One company attempting to change this situation is CAE with its Common Database (CDB) format, which it described as 'a shared, open and public database that defines a single synthetic representation of the world, and [can be used by] all simulation systems... The CDB is used as a run-time data repository from which the various simulation clients simultaneously retrieve relevant information to perform their respective run-time simulation tasks.

'The bottom-line result is that with the CDB, the creation, modification and correlation of run-time databases can take minutes or hours instead of days, weeks or months. Just as importantly, these changes can be made very rapidly using the latest intelligence and source data available,' said the company.

In September 2016, the CDB was formally accepted by the Open Geospatial Consortium (OGC) and is now usually referred to as the OGC CDB.

Up to speed

As well as issues surrounding commonality and the subsequent re-use of visual databases, a key user requirement concerns the time it takes to create one.

In Canada, Presagis specialises in providing a variety of software products to enable users to create a complete simulation environment. The company's database software tools (Creator and Terra Vista), simulation applications (Ondulus, STAGE, FlightSIM and HeliSIM), and visualisation software (Vega Prime) are aimed at allowing users to work faster and more efficiently.

The question of speed is vital in today's fast-paced world, where military forces might have to deploy rapidly. During this year's Defence Simulation, Education and

Titan Vanguard is forming a key component of Calytrix Technologies' workshare for JP9711 in Australia. (Image: Calytrix Technologies)

Training (DSET 19) conference, MG Maria Gervais, head of the US Army's STE programme, told delegates: 'I want to be able to point at the globe and say: "I want to train there." We can't do it now, but a common architecture can make it happen in the future. We need less hardware and more software-driven training.'

One of the critical elements in creating speed is allowing software tools to work together, and Presagis has brought its offerings together into a single suite, the latest iteration of which was launched in January this year and is known as M&S Suite 18.

'We are proud of what we accomplished with regard to the M&S Suite and responding to our users' needs,' explained Stéphane Blondin, VP of product management and marketing at the company. 'The enhancements and performance improvements in this release bring substantial value to the suite and truly optimise the investment our customers have made in our products. Presagis is committed to delivering market-leading products and continues to prioritise workflow, performance and innovation.'

Presagis has a software-centric approach – its Creator and Terra Vista database creation tools and Vega Prime visualisation tools work in concert with its remaining simulation software to provide total solutions.

The same can be said for VT MÄK, which offers its VR-Vantage IG (image generator) alongside the MAK Earth whole-earth procedural terrain and VR-TheWorld Server (streaming terrain server) to create a unified simulation solution.

This need for database creation to be as rapid as possible means that many companies, such as Collins Aerospace, provide whole-earth visual databases with areas of operational interest infilled with high-resolution terrain and urban detail.

Driven by data

The availability of high-resolution source data is vitally important when it comes to the end product.

'There is a strong correlation between improved database fidelity and the increasing proliferation of high-resolution source data, much of which is publicly available,' explained Scott Davidson, lead developer for MetaVR Terrain Tools. 'Geospecific vector data for buildings and land allow entire cities and forests to be created in days, rather than weeks or months. The output is much more varied and realistic as well. Our round-earth terrain creation tools – MetaVR Terrain Tools for Esri ArcGIS – and workflows continue to adapt to keep pace, as does our render engine [MetaVR Virtual Reality Scene Generator].

'As an early adopter of small UAS/UAV data capture, MetaVR's partnership with Swift Radioplanes opened the door to creating sub-inch-resolution geospecific terrain, something that seemed unrealistic years ago,' he continued.

One provider of high-resolution source data is Vricon. Formed in 2015 and owned by Saab and DigitalGlobe, the company can provide elevation models at 0.5m resolution. Last year, Vricon teamed with Esri to provide its data in ArcGISPro format, a facility that allows its data to be viewed in large swathes as opposed to smaller areas.

Clearly, such real-world or geospecific data are expensive to gather, manipulate and process, but the benefit is realism when compared to geotypical data. However, it appears that the expense argument is open to challenge.

'I would simply ask by what metric geospecific terrain is considered too expensive: "Do you mean that warfighters do not deserve to be given a competitive advantage by providing them terrain that looks exactly like the area in which they will be fighting?"' said W Garth Smith, CEO and co-founder at MetaVR.

'"Do you mean it is too expensive when compared to a [Program Executive Officer for Simulation, Training and Instrumentation] that spends nearly $100 million on a failed simulation programme that produces no meaningful simulator?" How does one qualify "expensive"? Is it too expensive because the individual complaining is unable to go geospecific with their infrastructure as opposed to ours?

'It's only expensive because they cannot do it efficiently and they are trying to compromise the warfighter by allowing bean counters to dictate simulation fidelity to increase their return on their investment – it's Catch 22 simulation,' he concluded.

More than a game

When she addressed delegates at DSET 19, Gervais said that her vision for STE involved the exploitation of the 'gaming industry' and that STE would 'leverage it' to provide improved training in the future and to achieve a 'one-world terrain' for a more holistic approach to training.

At I/ITSEC 2018, Bohemia Interactive Simulations (BISim) unveiled a 'cloud-enabled virtual-world technology'. Central to this offering is the company's VBS Blue IG, where the rendering engine and the global terrain database are separate.

This approach means that the rendering engine does not use compiled terrain formats, but uses the system's architecture, legacy and emerging data formats. The delivery of this One World Terrain, as BISim refers to it, fits squarely with the US Army's STE programme, and the company is now under contract to prototype further STE concepts.

'The US Army's vision for STE marks a monumental change in how they acquire, develop and deliver new simulation and ▶

virtual training technologies to soldiers,' said Pete Morrison, co-CEO and chief product officer at BISim. 'Our new suite of technologies will raise the bar on the performance and scale of virtual training. The new technologies offer training on a global scale with rich environments using cutting-edge artificial intelligence and cloud processing techniques.

'Additionally, the technologies are built with backwards compatibility and open standards in mind, allowing our customers to transition at their own pace and get maximum value out of their historic investments,' he added. 'The innovative solutions we are developing to assist the US Army will help shape the future of how virtual training is used to enhance operational readiness.'

BISim entered the market on the back of its gaming history, but products such as VBS Blue IG or VBS3 can no longer be referred to as serious games. Ten to 15 years ago, gaming areas were small and limited to first-person shooter or squad tactics, but as we have seen with BISim's One World Terrain, there have been fundamental changes that have occurred in this sector of the simulation industry.

In Australia, Calytrix Technologies has teamed with Titan IM to provide a Common Synthetic Environment (CSE) (see p36). 'I wouldn't use the term "visualisation", as our vision, excuse the pun, is far broader. Calytrix and Titan IM are committed to delivering the "second wave" of simulation, one that is not constrained by our legacy tools but rather delivers a complete refresh of our technology,' explained Shawn Parr, CEO at Calytrix.

'So yes, while many people are impressed with the quality of the visualisation that Titan produces out of the box, it is far more than just an old-school image generator but rather a complete CSE that includes a usable global terrain, CGF/AI capabilities and a new class of intuitive end-user tools, and in the process, reduces the cost of ownership currently constraining users,' he added.

As BISim has gained a toe-hold in the US Army's STE programme and also in the UK's Constructive Training Transformation Programme, and Calytrix is part of the Australian Defence Force's JP9711 programme, it would appear that the adoption of erstwhile 'games' technologies have broken through a significant barrier.

Historically, the arguments aimed at games-based systems were that they were closed systems that had discrete databases that could not be altered. Over recent years, this has changed.

BISim began to change attitudes with the purchase of TerraSim in 2013. TerraSim had developed TerraTools and other source-data preparation products used to aid the development of visual simulation databases.

MetaVR's Fallon database complete with T-6 model. (Image: MetaVR)

Rich landscapes

In Europe, TrianGraphics released its TrianBuilder 6.5 in August 2018. In addition to a new Autodesk FBX exporter (a translator for visual file formats) optimised for Unity, the new system integrates its database-generation tools with Titan Vanguard and VBS3.

Berlin-based TrianGraphics said that 'OpenStreetMap format is now directly loaded from online servers, and one-way roads are automatically fixed with an offset. An improved height brush and best-matching algorithms to place buildings on footprints complete the feature set of version 6.5. Furthermore, Trian3DBuilder has been updated to OpenSceneGraph 3.4.1.'

A partnership with Calytrix Technologies means that Trian3DBuilder supports the former's Titan Vanguard simulation environment to allow the import and export of georeferenced 3D models.

TrianGraphics has been providing a professional toolset for 3D environment generation based on GIS data since 2007. The company's Trian3DBuilder includes tools for the generation of flight, driving and maritime virtual landscapes, including automatic airport, road network and pier construction. Editing tools are used to enhance virtual environments based on GIS dataset.

Adopted by major simulation providers such as Rheinmetall Electronics, 'the workflow process is designed to easily create large landscapes with rich detail in a short amount of time. The upcoming Trian3D Unreal Engine Exporter harnesses these functionalities and outputs ready to use UE4 [Unreal Engine 4] scenery,' according to TrianGraphics.

The first public demonstration of the Trian3D Unreal Engine Exporter will take place at ITEC 2019 in Stockholm.

As an indicator of how games producers are now seeking assistance from the professional database sector, TrianGraphics has recently received a $500,000 grant from Epic Games as it is developing the UE4 using Epic's new Datasmith software developer kit.

TrianGraphics stated: 'Datasmith is designed to bring entire pre-constructed scenes and complex assemblies into Unreal, regardless of how large, dense or

CAE's Medallion 6000 IG uses the OGC CDB database standard. (Image: CAE)

heavy those scenes may be. A generated scene can be reloaded and updated in Unreal without losing the previous editing. Furthermore, intelligent data preparation, adding smarter runtime behaviours and tailoring the imported content for maximum performance are included.'

Complex terrain

Times have certainly changed as far as visual database development is concerned. Industry is moving ever closer to a commodity-based approach to visual databases whereby content is downloaded from the cloud as and when needed.

Although the technologies offered by the likes of BISim and Titan/Calytrix Technologies are gaining ground for specific applications, the demand continues for geospecific databases for high-end training to achieve the optimal training solution.

'MetaVR has a long history of closely working with customers to develop databases for their training,' explained Davidson. 'The database we created of the Fallon Range Training Complex at NAS Fallon, Nevada, is a good example. The Naval Aviation Warfighting Development Center at NAS Fallon needed high-fidelity terrain for use with range familiarisation for JTAC training. MetaVR and Swift Radioplanes spent two days capturing source data on some of the closed ranges.

'The resulting 66km^2 of 2cm-imagery-resolution terrain was blended with our CONUS++ terrain with 1m imagery and 10mpp elevation resolution. Details such as small craters from exploded ordnance and other training targets are clearly visible in the virtual environment,' he explained.

Another example was provided by Kristin Blier, terrain engineer at MetaVR, who told *Shephard* that the company was 'recently chosen to upgrade the visual systems of the F-16 full mission trainers by the Portuguese and Belgian European Participating Air Forces. The upgrade called for delivering round-earth geospecific terrain of Europe and for the creation of 3D high-resolution airfield models located in Belgium and Portugal.

'This upgrade included creation of two geospecific Belgian airfields (Florennes Air Base and Kleine Brogel Air Base) and the Monte Real Air Base in Portugal. In addition to creating these areas of interest with our Terrain Tools, we used Esri's CityEngine software to generate thousands of buildings surrounding the airfield culture. These models included geotypical textures and emissive light-map textures,' she said.

'We also worked closely with the customer to deliver a terrain product that included taking their existing runway models and integrating them into our virtual round-earth terrain,' Blier continued. 'The simulators will be used for take-off/landing, procedural response training, air-to-air and air-to-ground tactical training (including weapon employment), and in customised pilot scenario training configured for use in real-time, immersive environments.'

Building models

Visual databases are not all about terrain, urban features and airfields of course. A number of companies specialise in the provision of building interiors to enable movement through urban terrain and into buildings.

In Israel, bdesign3D's 'interactive 3D models of buildings' interiors are used by security teams, first responders and operators of C2 systems. 'The models are detailed geospecific and geotypical 3D representations of compounds and provide a live or real-time safety and security plan for different teams or military forces that might be involved in an emergency event,' said the company.

'Interior 3D models are also used in SWAT team training and simulation, training in military operations in urban terrain, mission rehearsals and even architectural planning. Interior 3D models are created by using ultra-high-accuracy geodata in order to reach ultra-high levels of resolution and realism at 2cm per pixel,' added bdesign3D. ■

Calytrix Technologies not only develops innovative integration, networking and software solutions but also delivers training services. Established in 2002, the company has just been selected as a partner of Lockheed Martin for Australia's JP9711 programme. **Shawn Parr**, CEO at Calytrix, explains more.

Momentum for change

Calytrix evolved at the height of the dot-com bubble to commercialise 'some new IP from our partner university', explained Parr. Not having a customer for the technology made it difficult and was 'an approach I probably wouldn't try again', he added. 'As luck would have it, we teamed up with Boeing at the time and started to look at distributed simulation and training in the defence sector and have never looked back.'

Core foundation

One significant development for Calytrix has been its teaming with Titan IM to offer the Titan Common Synthetic Environment (CSE), a technology that Parr balks at calling 'visualisation'.

'Our vision is far broader, as we are committed to delivering the "second wave" of simulation, one that is not constrained by our legacy tools,' he said. In other words, 'a complete refresh of technology'.

According to Parr, CSE 'includes a usable global terrain, CGF/AI capabilities and a new class of intuitive end-user tools, and in the process, reduces the cost of ownership [that is] currently constraining users'.

With its HQ in Perth, Australia remains 'the core foundation of our business', stated Parr. 'We have a proven track record of delivering systems and services right up to the largest-scale joint/collective training exercise, such as the bi-annual *Talisman Sabre* event between Australia and the US. Australia will always remain a key customer for Calytrix.'

Exports also contribute to the company's success, notably Austria, which recently procured a full enterprise licence for Titan. 'More than a dozen' other countries use the system, and Calytrix has also been 'heavily involved in the US Army's STE [Synthetic Training Environment] programme, where we have been demonstrating the opportunities that new technology can bring over re-worked legacy systems'.

Modern toolset

Looking forward, Parr sees 'the next few years being pivotal' for the T&S community, as there is a 'growing appetite for change' due to the 'slow rate of change... and cost... to create training'.

Far from being disheartened, Parr told *Shephard* that this 'momentum for change has already started'. He used the Australian JP9711-1 Core Simulation Service as a case in point, for which Calytrix is a partner to prime Lockheed Martin. Parr said that MSaaS (Modelling and Simulation as a Service) delivered 'over its cloud infrastructure, notably with Titan CSE at the heart of the technology refresh.

'This programme is closely followed by the US STE and CTTP/DVS2 [Collective Training Transformation Programme/Defence Virtual Simulation] teams in the UK, who – through their industry engagement – have indicated that "good enough for now" will not do, and that any future systems or software must be flexible in both technology and approaches to contracting and delivery,' he explained.

'I believe we are going to see real innovations over the next few years, and the winner will be the end-user, who will have new options and new ways to engage with simulation,' Parr continued.

He confirmed that Calytrix has 'several roles' as part of JP9711-1, which include the 'delivery of system/software engineers, terrain experts and... training delivery SMEs', in addition to 'key technology enablers to support the growing demand of exercise support across the Australian Defence Force [ADF]'.

> ***"Any future software must be flexible in both technology and approaches to contracting and delivery."***

Describing the Titan system, Parr said: 'Titan was chosen over existing products already in operation as it not only delivers a modern toolset but directly answered that cost of ownership, allowing JP9711-1 to deliver training at a higher quality and tempo for a fraction of the cost/time of traditional LVC approaches.

'In addition to Titan, we are providing simulated radio communications infrastructure and exercise planning tools, which – when combined with Lockheed Martin's simulation systems – will form the basis of the ADF's sovereign-owned federation available on demand from the cloud,' he added.

Parr believes that the JP9711-1 'will put the warfighter at the heart of its development [by putting] technology into their hands to deliver what they want, when they need it, wherever they need it [and] to deliver an environment that enables instruction, training and experimentation immediately on contact, without lengthy and costly user-training or further expensive engineering support'.

Parr spoke to Trevor Nash

Ministry of Defence
Thailand

Defense & Security 2019

18 - 21 November 2019

IMPACT Exhibition and Convention Center
Bangkok, Thailand

Tri-Service Asian Defense & Security Exhibition
Conference and Networking Event

Held in Conjunction with:
ADMM
ASEAN Defence Ministers' Meeting

For more information please contact:
Ms. Yaowalak Chuvichien, Senior Sales Manager
+66 (0) 2036 0500 ext 212 Yaowalak@asiandefense.com

Official Publication:
Official Show Daily:
ADJ

Official Bilingual Show Daily:
ARMADA
ASIAN MILITARY REVIEW

Official Exclusive Media Partner:
GBP AEROSPACE DEFENCE

Supporting Publications:
MILITARY TECHNOLOGY
DEFENCE REVIEW ASIA
JED
KANWA
DEFENSE
SHEPHARD
ARMS JOURNAL
Jane's
AVIATION & MILITARY
DEFENCE

Strategic Partner:
DSA 2020
NAT&EC ASIA 2020
20 - 23 APRIL 2020
KUALA LUMPUR, MALAYSIA

Officially Supported by:
TCEB

Organised by:
GML

+66 (0) 2036 0500 info@asiandefense.com @DefenseThailand #DefenseThailand2019

www.asiandefense.com

Who is the leading provider of high-fidelity helicopter training systems and services?

We are.

Helicopters continue to serve a variety of critical roles for defence forces, thus requiring high-fidelity and capable training solutions. We provide innovative simulation products and comprehensive training services to help prepare helicopter aircrews for their demanding missions, as we have done for the U.S. Navy, German Armed Forces, UK Ministry of Defence, Royal Australian Navy and other militaries around the world. Recently, the Royal New Zealand Air Force selected CAE to support its NH90 helicopter training with the new CAE 700MR Series flight training device designed specifically for military helicopter training.

No company has designed training systems for a greater variety of helicopters, which means we have the experience and expertise to serve as your training systems integrator in the development of world-class helicopter training and mission rehearsal solutions.

milsim@cae.com @CAE_Defence CAE @CAE_Defence cae.com/defence-security

Your worldwide training partner of choice

CAE