Defence Industry Bulletin

Insider knowledge for the discerning defence and security professional

Issue #9 April 2016

UKRAINE PLEDGES DEFENCE SPENDING

BIG INTEREST IN US NANO RFP

AUSTRALIAN NAVY WELCOMES AEGIS TESTS

WHY VERTICAL LIFT COULD 'SHOCK THE WORLD'

INTERVIEW

RUSSIA'S EXPORT PLANS EXPLAINED

UK'S 40MM TURRET TAKES AIM

EXCLUSIVE INSIGHT ON INDIA'S EXPORT HOPES

HYBRID POWER: A GREENER NAVY NOW

Defence Industry Bulletin

Welcome to Defence Industry Bulletin

Spring has finally arrived. For those involved in the defence industry, there are hopes that technologies will begin to bloom and that new windows of opportunity will open. In this issue, Defence Industry Bulletin invites you to stop and smell the flowers with fresh news, insight and opinion on a number of important developments – including a special on green energy…

In The Broader Picture, Oliver Austin reports on Egypt's $3.7bn French military loan and Ukraine's pledge to invest in its National Guard. Meanwhile in the Land section, Victor M.S. Barreira updates us on the latest with Turkey's Altay MBT project and reports on the new periscope system for the Brazilian Army's M113BR APC. DIB has insight on the U.S. Army's interest in the nano UAS market and its budget for a new ultra-light armoured vehicle.

The F-35 recently undertook its first transatlantic flight from Italy and we had Eugenio Po on the ground to give us the latest. Also in the Air section, the Italian Air Force's HH-101 CSAR helicopters reached initial operational capacity and we get insight on Romania's deal for its first new fighter jets in September.

At sea, Defence Industry Bulletin reports on Italy's Multipurpose Patrol Ship (PPA) as General Electric is picked to supply the gas turbines while Fincantieri starts building the Logistic Support Ship at its shipyard in Castellammare di Stabia. We also have the latest as Lockheed Martin begins test and integration of the Aegis combat system on the Royal Australian Navy's air warfare destroyer (AMD) and news of the Stingray as it replaces the U.S. Navy's UCLASS

In The Briefing Room, our correspondent Rory Jackson is reporting from the first ever Abu Dhabi Aerospace and Aviation Week where he spoke to Motion Reality Inc. about its Dauntless system helping militaries and federal agencies train their troops in an immersive and reactive environment. He also interviews General Atomics about the future for the Predator XP. Georg Mader speaks exclusively to Russia's ROSOBORONEXPORT at the Bahrain International Airshow about its interests in the Middle East and interviews India's 'Tejas' programme-director about progress of the Light Combat Aircraft (LCA).

As always, we hope you learn something useful.

Andrew Elwell and Richard de Silva

Front cover image: V-280 concept art; courtesy of Bell Helicopter; This page: Graphic by kentoh/Shutterstock

The Broader Picture

Egypt approves $3.7bn French military loan *Oliver Austin*

Egypt's Parliament has approved a $3.7bn (€3.37bn) loan from France to fund the acquisition of military equipment, primarily for the Air Force and Navy. The deal also provides provisions for the induction of French weapon systems in the coming years.

Under the terms and conditions, the defence ministry will collaborate with French banks led by Crédit Agricole for Comp-anies and Investment Bank, which will provide the loan at 60 percent of the total equipment value. Egypt will pay the remainder of the bill outright for an estimated total of $6.36bn (€5.62bn). The loan is reported to have been guaranteed by the Egyptian Ministry of Finance.

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As part of their efforts to increase internal security and continue their attack on jihadist positions, the Egyptian Air Force has ordered 24 Dassault Rafale multi-role fighters along with advanced air-to-air and air-to-ground munitions. The first three of these aircraft were in July 2015.

Aside to the acquisition of two Mistral-class aircraft carriers from France in 2015, the Egyptian Navy has also ordered a DCNS FREMM multi-mission frigate and four Gowind 2500 corvettes/light frigates (with 45 MM-40-3 Exocet missiles), with delivery due to begin in 2016 and completion by the end of 2017.

Demonstrating the strength of their partnership, both nations teamed up in March to undertake joint manoeuvres in the Mediterranean as part of the Ramses 2016 Exercise.

Russia has also benefited from Egypt's increased defence spending since 2013. After securing the Mistral-Class platforms from Paris (originally intended for sale to Russia), Cairo made a deal with Moscow to purchase 46 Ka-52K Russian-made naval attack helicopters, which are already compatible with the carriers.

Egypt has ordered 24 Dassault Rafale multi-role fighters. Image: Thor Jorgen Udvang

The Broader Picture

Ukraine honours National Guard with new investment pledge *Oliver Austin*

Ukraine is planning to increase its defence capabilities to fulfil the requirements of both the National Guard and Armed Forces, including the purchase of new equipment and the modernisation of existing assets.

According to comments made by Oleksandr Turchynov, Secretary of the National Security and Defense Council of Ukraine, and reported by Ukrainian national media, investment must be made because "the threat from the aggressor does not become smaller. In order to defend the country, we will continue to enhance the defence capabilities, ensuring the needs of the National Guard and the Armed Forces in military equipment and modern weapons."

"The National Guard defends Ukraine not only at the front, but also protects the lives and the peace of its citizens in all regions of our country, counteracting the internal enemy, terrorists and saboteurs, as it was on August 31, 2015, near the Parliament of Ukraine. We are proud of you the real knights and heroes of Ukraine."

> Kiev's politicians are considering a "revamp" of the government with the possibility of a new ruling coalition

Turchynov's comments were made on the Day of the National Guard of Ukraine (26 March), commemorating the establishment of the service just two years prior by President Petro Poroshenko. Turchynov himself was the author of the law that created the Guard, and personally signed the bill twice, as head of the Verkhovna Rada (Supreme Council) and as the acting President.

At time of writing, Kiev's politicians are considering a "revamp" of the government with the possibility of a new ruling coalition and changes to the cabinet. The change is said to be critically important for reforming the economy and avoiding the possibility of pro-Russian militants taking advantage of the fiscal crisis.

President of Ukraine Petro Poroshenko during a visit to the training center of the National Guard of Ukraine in Novi Petrivtsi. Image: Shutterstock

The Broader Picture

The Hour of Power: Hybrid Technology for Security and Military Applications *John Haynes*

Hybrid is 'here and now' technology that is being utilised by many transport sectors and industries around the world. The professional and military sector is now recognising the potential of utilising hybrid power and innovative propulsion systems for vessels in the sub IMO / sub 24 metre (80 feet) sector.

Certain maritime sectors are potentially well suited to hybrid diesel / electric systems. These include ferries, harbour tugs, workboats and pilot boats that have relatively consistent duty cycles. For military applications hybrid systems, including battery / electric with diesel, are relevant to patrol, interception, loitering and autonomous vessel duties.

'The Hour Of Power' concept enables vessels to run in and out of port for an hour on electric with battery power - then carry out their open sea work on diesel power. The aim of this innovative hybrid solution is to enhance conventional power and propulsion systems. Vessels can reduce emissions and improve fuel consumption whilst extending engine maintenance periods and engine life. The Hour Of Power can also be utilised to extend military capability.

Green Energy and Military Power

In 2015 two significant developments made many operators and builders of professional vessels consider hybrid marine power. Firstly the new emissions laws in ports and secondly there is now an incentive for high technology manufacturers to invest in developing highly efficient batteries. These drivers for environmental change will create new technologies that have military applications.

This is not just green energy for the sake of it. 'The Hour Of Power' focuses on hybrid solutions linked to viable business cases. For professional organisations the concept of running vessels with zero emissions at 10 knots for one hour will shape decisions that lead to improvements of in-service systems and procurement of next generation vessels. The overall objective is fuel saving and improved efficiency by all means.

> Parallel systems are more likely to win initial market acceptance because of a perception of greater reliability

For military applications hybrid systems, including diesel / battery / electric, will give patrol vessels the ability to turn off main engines then loiter silently with a low heat signature. Patrol vessels will still use their main engines to move rapidly from point to point, once in position a vessel can patrol slowly on battery electric power. This will be particularly relevant to vessels undertaking low speed port or estuary patrols. Stealth and the element of surprise have many applications for customs, borders and fisheries protection.

Hybrid Power and Security Operations

As the requirements grow for 24/7 security in many ports and waterways Unmanned Surface Vehicles (USV) will be considered for various roles and the drivers for rapid technology development are significant. As no crew changes are required USVs can remain at sea for days at a time. As diesel engines were not designed for 'start – stop' operation, hybrid systems that use stored energy will be a viable solution for USVs. At the start of a mission batteries can be fully charged from shore power or the mother vessel. During the mission batteries can receive their main charge from a diesel generator. A secondary charge can be provided by solar power and in the near future alternative sources of energy, including wave action.

Sustainable sources of free energy can be applied to unmanned vessels when on extended duration tasks.

Serial and Parallel Hybrid Power Systems

Submarines have utilised stored energy for many years. Diesel / electric systems have been used in large ships for many years but these are not hybrid systems. The diesel / electric vessel uses its engines to connect directly to an electrical generator, the power in the system is then transferred electrically to the propeller shaft via a motor controller and electric motor. The system may have multiple generators and multiple motors. By strict definition this is not a hybrid as there is no storage of electric energy. ➧

The Broader Picture

There are currently two main types of hybrid system. Firstly, a serial hybrid, where the engine in the system only powers a generator and is not mechanically connected to the propeller shaft. Secondly, a parallel hybrid, where the engine is mechanically connected along with an electric 'machine' that can operate as both a propulsion motor and a generator. The reduced electric propulsion, generator and battery demands of a parallel system substantially reduce the cost compared to a serial system. Parallel systems are more likely to win initial market acceptance because of a perception of greater reliability, as the 'trusted' diesel engine is still connected to the propeller shaft with the electric propulsion adding a redundant system.

Until recently it has not been possible to transfer such systems successfully to smaller craft. A European Union funded project called HYMAR (High efficiency hybrid drive trains for small and medium sized marine craft) set out to develop an optimised hybrid system. HYMAR developed a parallel hybrid system that has been installed, tested and validated on marine craft. The optimised hybrid system developed during the project offers three major advantages – no detectable emissions, no discernible noise and a substantial reduction in fuel consumption. Although the obvious advantages are 'environmental', military benefits include low signature plus a reduction in fuel consumption which offers increased operational range.

> A ferry could offer the perfect work cycle for 'electric only' with a land based charging system

Hybrid Power and Propulsion Systems Increase Efficiency

We are entering a period of rapid change and commercial opportunity in the hybrid marine market. Boat builders, engine manufacturers, designers and naval architects are now developing systems for survey vessels, superyacht tenders, patrol vessels and unmanned craft. Benefits include improvements in energy reliability, increased fuel efficiency, lifecycle cost reductions and redundancy. DNV-GL USA recently stated that, 'energy storage is an exciting new technology, but the offshore E&P sector of the oil and gas industry has yet to truly take advantage of it. Tugboats, workboats and offshore support vessels are particularly suitable for hybridization.'

When studying work cycles of vessels it is relatively straightforward to make a decision for new builds on whether to go for all electric or a diesel / electric hybrid system. For example, a ferry operating over a short route with a long stopover each end could offer the perfect work cycle for 'electric only' with a land based charging system. Other issues, such as the cost of downtime and structural alterations affect viability calculations for retrofit of in-service craft.

BAE Systems is a provider of hybrid propulsion systems with technical experience in hybrid technology for land based applications. David Adamiak, Senior Manager Business Development at BAE Systems HybriDrive said, 'From over ten years experience supplying hybrid technology ➔

The Maritime Aquarium at Norwalk research vessel 'Spirit of the Sound' is equipped with BAE Systems HybriGen technology

The Broader Picture

to land transport sectors we know that cost-benefit calculations start with the initial purchase of the system. Payback periods can be based on the life cycle of the vessel and life cycle of the hybrid power system. Once a system is defined projections of savings can be based on engine management data linked to work cycles.' Hybrid systems are infinitely scalable which enables en users to specify what they are trying to achieve over a period of time or an entire fleet. David Adamiak added, 'We supplied a HybriDrive system to the 19 metre (62 feet) research vessel Spirit Of The Sound. She runs virtually silently on battery electric power for two hour study cruises on Long Island Sound.'

Military Hybrid Systems and 'The Hour Of Power'

Certain military sectors are potentially well suited to 'hybrid' diesel-electric systems. Riverine operations could benefit from a silent running mode when patrolling or transiting towards an area of interest. For specialist operations, boat teams could utilise stored energy to approach the target in silence. Once the energy is onboard engine designers could also configure the main engines to use extra kilowatts of battery power to create an increased top speed for short bursts.

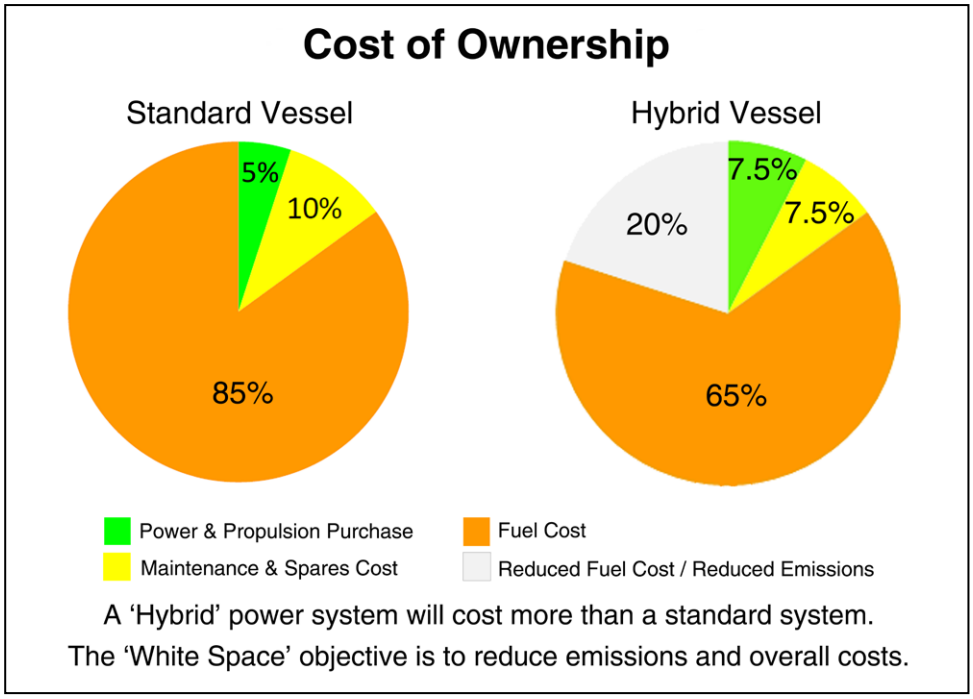
Riverine operations could benefit from a silent running mode when patrolling or transiting towards an area of interest

Focus is now on the sub IMO / sub 24 metre (80 feet) workboat, and patrol craft sectors to investigate the engineering and systems integration required to bring together viable and sustainable solutions. With vessel life cycles of over 20 years, naval architects and builders of new craft will offer designs that have space and access routes to enable retrofit of hybrid installations.

Speed limits in harbours and channel approaches at beginning and end of daily transits mean that 'The Hour Of Power' battery /electric could be engaged for that part of the cycle to reduce emissions in ports and to reduce the hours of running main engines at inefficient low speed loads. Military exercises that require extended command and control from slow moving or stationary vessels could utilise stored energy from high energy battery systems.

65 metre Offshore Supply Vessel with hybrid propulsion system for the Italian Coastguard. Image: Siemens AG

The Broader Picture



Cost of Ownership : A comparison of standard and hybrid propulsion.

Next Generation Cells and Batteries

For the marine industry to move forward it needs to utilise expertise from aviation and other sectors to drive this innovation and support relevant safety standards. Automotive manufacturers in Europe, the Far East and the US have recognised that hybrid technologies such as PHEV (Plug-in Hybrid Electric Vehicle) utilising lithium ion batteries will be dominant for the next decade. The need for self sufficient land based grid applications has further extended the capabilities of next generation battery and hybrid technology.

Michigan based XALT Energy offer several variants of High Energy, High Power, and Ultra Hi-Power cells. Robert Young, Technical Lead for Marine Applications at XALT Energy, said, 'our team of engineers have worked to the highest standards developing electric and hybrid energy solutions for the automotive sector. XALT Energy not only has the necessary knowledge, but also the experience of taking high voltage battery projects from concept through production into the finished system.'

The next generation of cells and batteries are key technology developments that are making marine hybrid systems potentially viable. Battery chemistry such as Lithium-ion offer impressive power solutions and the business case is starting to fit for professional operators. Since there is no single system that fits every application it is important to work with manufacturers that have flexibility in cell manufacturing and offer scalable solutions. New factories with fully automated processes are designed to ensure consistently high quality cells and quality control of the entire battery management system.

Robert Young added, 'We are now working with boat builders, naval architects and marine operators to analyse different maritime duty cycles. Engine management data can be matched to battery characteristics to develop the most efficient solutions. XALT Energy onboard energy management systems are designed to ensure that battery systems operate at optimum performance. The objective is hybridizing and electrifying marine vessels to produce systems that are geared to end users requirements.'

Hybrid Marine Power and Propulsion Workshop

In 2015 the Hybrid Marine Power & Propulsion workshop brought together a group of experts in to explore the possibilities of utilising hybrid power and propulsion systems in the professional marine sector. Focussing on sub IMO / sub 24 metre (80 feet) vessels, the group highlighted the potential of the Hour Of Power concept for workboats, pilot boats, harbour service vessels and patrol craft.

The military has many uses for efficient small to mid size engines. Electric outboard engines are now proven and their power sizes are increasing. Christoph Ballin, co-founder & CEO of German manufacturer Torqeedo, explained the development of high-power integrated propulsion systems for serial production, 'Torqeedo Deep Blue hybrid power and propulsion for the professional marine sector is based around components of the proven and multiple innovation award-winning system for electric hybrid yachts. The hybrid system can provide drive systems and supply the power required onboard. The use of renewable sources of energy has also been integrated into the energy management system. Professional users of the hybrid system can travel silently and use environmentally friendly sources of energy at lower operating speeds.' ➡

The Broader Picture

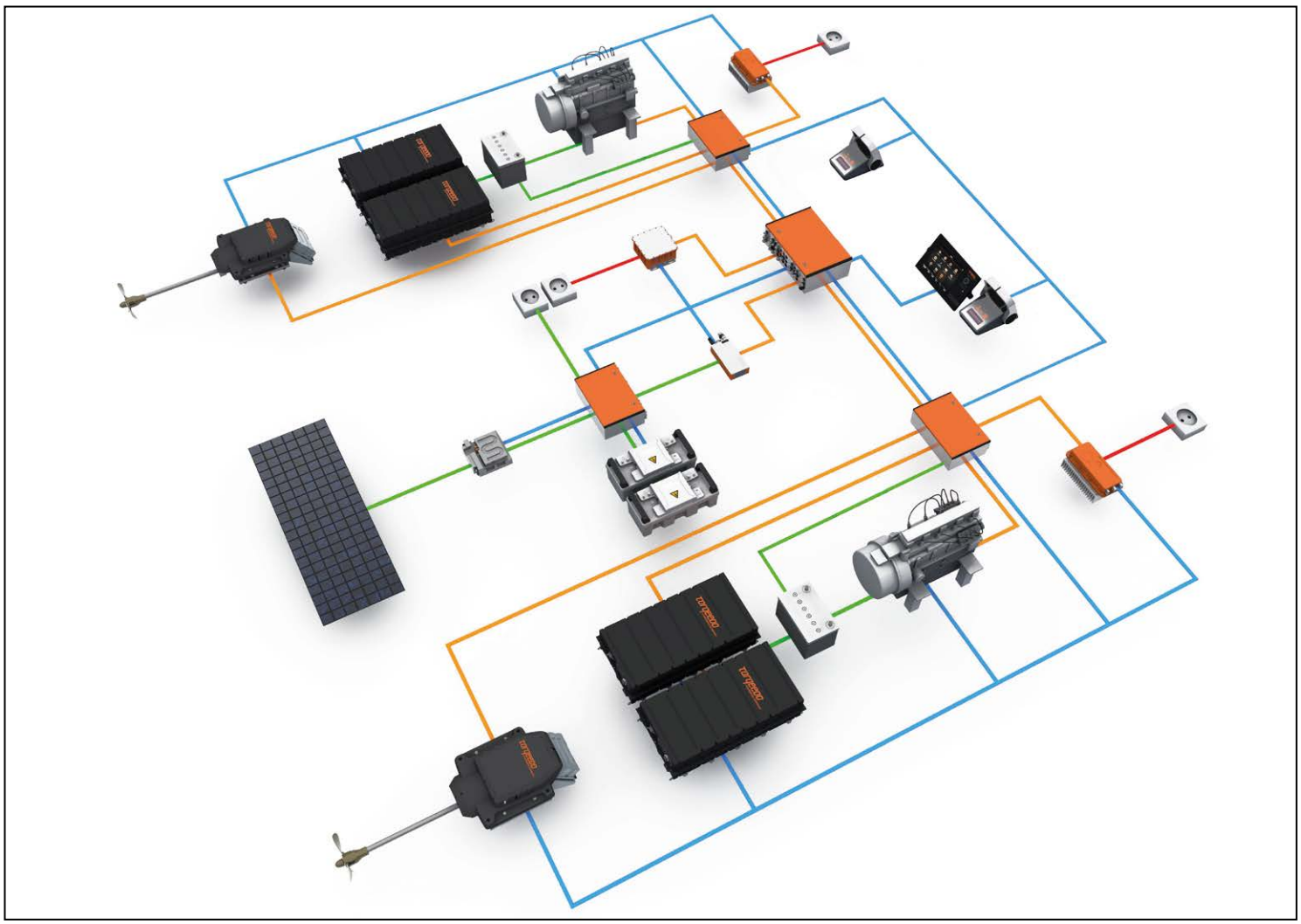
Looking to the Hybrid Future

For naval architects working in the commercial marine sector class rules, safety, performance and cost are relevant when considering innovative battery power and diesel electric propulsion systems. The challenge for designers of naval vessels is to engineer solutions utilising hybrid technology which are affordable plus manageable in terms of physical size, weight and maintenance.

As new sources of energy become available it is important to identify which energy source best fits the vessel, duty cycle and environment to give efficient power when it is needed. Since no two vessels, routes or captains are alike, decisions can be improved with data logging and analysis. Commercial Off The Shelf (COTS) power management systems will bring together diesel, electric and battery data to create optimised whole vessel hybrid systems.

As ocean going shipping, automotive and aviation move rapidly towards hybrid solutions it will be interesting to see how the military and security industry decides to utilise the numerous opportunities now available to them.

John Haynes is an Associate Fellow of the Nautical Institute, Yachtmaster Ocean and Advanced Powerboat Instructor. Subject matter expertise includes high speed craft consultancy, product development and specialist training. He is Operations Director of Shock Mitigation www.shockmitigation.com and founder of the RIB & High Speed Craft Directory that brings together specialist boats and equipment for the sub IMO / sub 24 metre professional sector worldwide www.ribandhsc.com.



Deep Blue hybrid by Torqeedo is a fully integrated scalable system offering hybrid power and propulsion.

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U.S. Army scanning nano UAS market *Joseph Carpenter*

The U.S. Army issued an RFI in March for a stand-alone, soldier-portable nano unmanned aircraft system (UAS).

> The vehicle should also be able to operate within a Line of Sight of 500m, boast an endurance of 15 minutes

Under the Soldier Borne Sensors (SBS) programme, the UAS intended for procurement will weigh no more than 150g, with the full system – including air element, ground element, batteries, carrying puch and display – will be just 3 lbs. It will transmit incoming video and telemetry data in near real time, day or night, and be able to feed back an image of sufficient resolution for for a trained operator to detect a man-sized target with a 90% probability at 100 metres (or 50 metres at night).

The vehicle should also be able to operate within a Line of Sight of 500m, boast an endurance of 15 minutes, and have the ability to be hand launched and recovered – without exposing the operator – while in a prone position in a concealed location. Meanwhile, light rain and gusts of wind up to 15 knots should not trouble the device. A full listing of the Army's minimum requirements was made available on the Federal Business Opportunities website.

A number of vendors are already said to be at the forefront of consideration if they opt to pursue the request. These include AeronVironment, makers of the Raven UAV, made headlines in 2011 with its 'Hummingbird' Nano Air Vehicle (NAV) developed for the Pentagon's Defense Advanced Research Projects Agency (DARPA), which could see development to meet the latest requirements. Proxy Dynamics also fields the combat-proven PD-100 'Black Hornet' PRS (Personnel Reconnaissance System), which is night-vision capable and can transmit video streams or high-resolution still images via digital data-link within a 1 mile range. Black Hornets have been in use with the British and Norwegian Armies and with several special operations teams, including those in the United States.

The Army will be holding a virtual Industry Day on 12 April, which will provide a forum for innovators to hear about the SBS programme directly from the Army and allow the programme manager to answer any questions.

The Black Hornet nano helicopter unmanned aerial vehicle (UAV) may be in the running for a US contract. Image: Richard Watt/MOD

India signs up for more military tractors, ambulances *Oliver Austin*

The Indian Ministry of Defence has awarded Indian automobile manufacturer Ashok Leyland an $128m (Rs 800 crore) contract to supply 450 field artillery tractors (FAT) 6X6 units, 825 ambulance 4X4 units and similar super stallion vehicles.

Vinod K Dasari, managing director of the Hinduja Group's flagship company, announced at the end of March that orders for Field Artillery Tractor (FAT) 6x6 and ambulance 4x4 are "in keeping with the momentum witnessed recently in the area of upgradation of technology and resources by the defence forces."

The FAT 6X6 on the super stallion cargo transport truck will be employed as a gun tower for all artillery guns and should also provide the Army more flexibility in deployment when managing its artillery resources.

Meanwhile, the super stallion vehicle can be used across various logistical segments, and the 4X4 will provide enhanced medical care in the immediate aftermath of battlefield injuries. A double insulated body of the ambulance would maintain temperatures inside the vehicle, while the rear air suspension would reduce the shocks caused during transportation.

Ashok Leyland's is currently India's largest defence mobility manufacturer, providing platforms across all three national services.

The Modi government is pursuing the 'Make in India' initiative, a new policy designed to reduce weapon imports from the current 70 percent of acquisition to approximately 50 percent in the next 10 years, with the country planing to spend $150bn on equipment in the next 15 years.

The FAT 6X6 on the super stallion cargo transport truck will be employed as a gun tower for all artillery guns

Ashok Leyland Stallion 4x4. Image: Ashok Leyland

Ultra-light vehicle RFP in US Army budget *Joseph Carpenter*

The US Army is expected to issue an RFP by the end of 2017 for its Ground Mobility Vehicle (GMV), the new name given to the armoured vehicle programme aimed at fulfilling the mobility needs of its light forces.

This GMV programme is not to be confused with the existing GMV 1.1 vehicle (Flyer-72) developed by General Dynamics for Special Operations Command. However, that company is likely to have an advantage in the new GMV competition given its SOCOM contract.

While decisions were finally made last year on the long-awaited Joint Light Tactical Vehicle (JLTV), intended as a replacement to the Humvee, officials are keen to outfit light infantry with a transportable and agile vehicle for rapid, forced-entry operations. So urgent is this requirement that the Commander of Army Training and Doctrine Command (ATDC) openly referred to the light forces' current mobility as being of "World War I" standard and declared the search for the ultra-light solution as the Command's "number one priority."

> Draft requirements include the capacity to be up-armoured and the ability to be sling-loadable by a UH-60 Black Hawk

At present, the Army plans to buy upwards of 49,000 JLTVs, produced by Oshkosh Corp. However, this vehicle is built with MRAP-level IED protection, while the GMV 1.1 is a 4,500 lbs platform intended to transport a nine-man infantry squad. With both vehicles too bulky for the discreet and stealthy mobility that the Army wants to provide for its smaller teams, an all-new alternative is seen as the only option.

Draft requirements for the new vehicle include the capacity to be up-armoured and the ability to be sling-loadable by a UH-60 Black Hawk (rather than a CH-47 Chinook required on the SOCOM vehicle).

The Army has so far assigned a provisional manager within the Program Executive Office Combat Support and Combat Service Support. The same portfolio will include development of the Lightweight Reconnaissance Vehicle (LRV) programme, which has had prototypes demonstrated recently at Fort Benning by the likes of Northrop Grumman, Rheinmetall and Navistar.

General Dynamics' Flyer-72 was selected for the SOCOM GMV contract. Image: General Dynamics

Turkey's Altay MBT project gathers speed *Victor M.S. Barreira*

Turkish armament procurement organisation SSM is expected to complete the qualification of the indigenously developed Altay main battle tank (MBT) later this year. The battle tank project was set up as part of the Milli imkanlarla Modern Tank Üretim Projesi (MiTÜP) project, which is looking to progressively replace existing vehicles fielded by the Turkish Land Forces Command. The qualification process is being executed jointly with Turkish Land Forces Command and the vehicle's main contractor Otokar Otomotiv ve Savunma Sanayi.

Following a decision by Turkey's Defense Industry Executive Committee in 2007, privately-owned Otokar (part of Turkish conglomerate Koç Holding) was awarded a $500m contract by SSM to carry out design, development, production, and prototyping with technical support and assistance by Hyundai ROTEM.

The 78-month project, known as Phase I (or Dönem I in Turkish), included "Conceptual Design", "Detailed Design", and "Prototype Development and Qualification" stages. One Mobility Test Rig (MTR), one Firing Test Rig (FTR), and PV1 and PV2 prototypes were later produced. PV1 and PV2 vehicles were completed at the end of 2014, with PV2 having been displayed at IDEF 2015 in Istanbul in May.

Prototypes are currently undergoing "System Qualification and Acceptance Tests" including endurance and reliability, mobility, protection, firepower, EMI/EMC, command and control assessment.

The incoming Phase II (Dönem II) will see a contract by SSM for serial production from 2018 of an initial 250 tanks and the supply of associated integrated logistics support. Otokar submitted a bid on 18 January 2016. Other Potential bidders include local firms BMC Savunma and FNSS Savunma Sistemleri. The first batch is expected to be followed by follow-on orders.

The Altay design fulfils a variety of operational requirements for the Turkish Land Forces Command. It has a specially designed hull which comprises a combination of flat belly and a special type of V-shaped hull. A monocoque chassis ensures structural integrity and enhanced protection.

The major subcontractors of the development phase were Aselsan Elektronik Sanayi Ve Ticaret for the electronics, Makina ve Kimya Endüstrisi Kurumu (MKEK) for the main gun and Roketsan for the modular protection package. Other Turkish companies are also involved including MilSOFT Yazılım Teknolojileri, Türkiye Bilimsel ve Teknolojik Arastırma Kurumu (TUBITAK) and Tepas ➔

The Altay battle tank during a fire session. Image: Otokar Otomotiv ve Savunma Sanayi

Elektrik Motorları. Savunma Teknolojileri Mühendislik ve Ticaret (STM) develops the Tank Komuta Kontrol Bilgi Sistemi (TKKMBS) integrated command and control system according to a contract from Aselsan Elektronik Sanayi Ve Ticaret.

Altay is equipped with a 120 mm/55 caliber smoothbore gun fitted with fume extractor, thermal sleeve, muzzle reference system and guided missile firing capability; power pack consisting of 1500 hp V12 diesel engine with 5 forward and 3 reverse gears coupled to fully automatic transmission; fire control system incorporating gunner's and commander's panoramic sights and gunner's auxiliary sight unit; life support system combining CBRN protection and air conditioning; automatic fire extinguishing and explosion suppression system; nuclear and chemical detection system; auxiliary power unit; laser warning system; Balistik Koruma Merkezi (BKM) modular composite armour system featuring various armour technologies including composite built-in and add-on armour modules and reactive armour modules; pre-heating system, automatic weather sensor; battlefield target identification system; battle management system; C3I system; front and rear thermal and day cameras for the driver; situational awareness system for 360 degree coverage; coaxial machine gun; remote weapon station; two banks of eight grenade dischargers each; hydro-pneumatic suspension; and electric driven gun turret drive system.

> The Altay design fulfils a variety of operational requirements for the Turkish Land Forces Command

The first vehicles were equipped with a Rolls-Royce Power Systems MTU MT 883 Ka-501diesel engine developing 1500 hp that is coupled to Renk HSWL 295TM fully automatic transmission, however a new powerpack is being developed by Türk Motor Sanayi ve Ticaret (TÜMOSAN) according to €190m ($216m) contract placed by SSM on 17 March 2015.
Aselsan Elektronik Sanayi Ve Ticaret was awarded a contract of 30 November 2015 for the design, development, test, qualification and production of two prototypes for an AKtif KORuma (AKKOR) active protection system for the Altay.

An armoured engineering combat version of Altay is also planned, and provisions will be made available to allow integration of mine clearing equipment into the platform.

UK receives first 40mm production weapon system for Ajax

Victor M.S. Barreira

CTA International (CTAI), a joint venture company between BAE Systems and Nexter Systems founded in October 1994, has delivered the first production standard 40 CTAS (Cased Telescoped Armament System) 40mm weapon system to the United Kingdom's Ministry of Defence.

CTAI was awarded a production contract for the CTAS in 2015 for the delivery of 515 gun systems over seven years. The weapon system will arm the Lockheed Martin-developed turrets for the 245 Ajax tracked armoured reconnaissance vehicles that General Dynamics UK will deliver to the British Army from 2017. CTAI's system will also arm the British Army's Warrior infantry fighting vehicles being modernised by Lockheed Martin UK according to Warrior Capability Sustainment Programme (WCSP). The remaining systems will be used for trials and training roles.

The CTAS weapon system is comprised of cased telescoped cannon; ammunition handling system; controller; gun control equipment; and gun mount. It fires 40mm cased telescoped ammunition such as APFSDS-T (Armour Piercing Fin Stabilised Discarding Sabot-Tracer); TP-T (Target Practice-Tracer); TPRR-T (Target Practice Reduced Range-Tracer); GPR-PD-T (General Purpose Round Point Detonating-Tracer); GPR-AB-T (General Purpose Round Air Burst -Tracer); TMR (Target Marking Round); and A3B (Anti-Aerial Air Burst) rounds.

> CTAI was awarded a production contract for the CTAS in 2015 for the delivery of 515 gun systems over seven years

The cased telescoped cannon was qualified in June 2014 as well as the 65 x 255mm long APFSDS-T and TP-T ammunition by UK's Defence Equipment and Support (DE&S) and France's Direction Générale de l'Armement (DGA). GPR-PD-T and GPR-AB-T ammunition are undergoing qualification.

The CTAS will also fit the Nexter Systems T40M modular ballistic protected turret that will equip the 248 Jaguar 6x6 reconnaissance and combat armoured vehicles to be delivered from 2020 to the French Army as part of the SCORPION (Synergie du COntact Renforcé par la Polyvalence et l'InfovalorisatiON) modernisation programme. Jaguar is being developed by a consortium formed of Nexter Systems, Renault Trucks Defense and Thales, according to contract awarded by DGA in December 2014.

The Jaguar vehicle will progressively replace AMX-10RCR and ERC-90D Sagaie 6x6 armoured reconnaissance vehicles, as well as VAB (Véhicule de l'Avant Blindé) vehicles equipped with MÉPHISTO (Module Élévateur Pour HOT Installé Sur Tourelle Orientable) quad-anti-tank missiles launching station.

The 40mm weapon system was also designed to arm Thales RAPIDFire truck-mounted self-propelled anti-aircraft gun system.

The Ajax armoured vehicle with CTAS turreted gun system. Image: General Dynamics UK

New periscope system for Brazilian Army's M113BR APC *Victor M.S. Barreira*

OPTEX Systems was awarded a contract in January 2016 by the US Government to deliver 31 M17DT day/thermal periscopes for the Brazilian Army's M113BR armoured personnel carriers (APCs). The first batch will be delivered in April, the company told DIB late January. This system enables 24 hour situational awareness by utilising two compact cameras and a 6.5-inch picture-in-picture monitor display.

The system was tested on Brazilian APCs during trials held at the Brazilian Army's Evaluations Centre in Rio de Janeiro in 2014. The M17 systems will replace the vehicle's standard M17 periscope.

The color CCD (Charge-Coupled Device) day camera has a 1/3" color sensor with a lens that provides a 48° vertical and 62° horizontal field of view. A FLIR Systems Tau 2-324 compact long wave infrared thermal imaging camera integrates a lens that provides a 39° vertical and 49° horizontal field of view. Both cameras are located within the main housing of the periscope, and feature video format output compliant with NSTC (National Television System Committee) standard. The monitor, which is a thin film transistor active matrix color liquid crystal display (LCD) with a 640 x 480 resolution, is located on the viewing end of the mount where the exiting image would normally be located on the M17 periscope.

A separate thermal camera programming cable for configuration control of the thermal camera, including black hot/white hot, digital zoom, and image optimisation control is available as option. A secondary display can also be incorporated in the system to allow additional viewers. In addition, a tactical video recorder can be incorporated in the system that provides 8 hours of record time.

The company has supplied sighting systems for a wide range of armoured vehicles including Abrams, M113, Stryker, LAV III, Merkava Mk4, M2 Bradley, AAV7A1 family and COMMANDO series vehicles.

A total 150 M113Bs were modernised by the Brazilian Army's Pq R Mnt/5 Regional Maintenance Park in Curitiba, State of Paraná, with assistance from BAE Systems as part of Brazil's strategic project Attainment of the Full Operational Capability (PEE OCOP). It included the installation of a Detroit Diesel Corporation 6V53T diesel engine and Allison Transmission TX-100-1A cross-drive transmission. Another 236 vehicles will receive identical upgrades according to a 2014 US foreign military sale (FMS) between the Brazilian Army and the US Department of Defense.

Brazil has seen 150 of its M113Bs modernised to M113BR standard, with another 236 to receive identical upgrades. Image: BAE Systems

Each MLT launch platform is armed with up to eight missiles. Image: Victor M.S. Barreira

France receives last Mamba mobile air defence system *Victor M.S. Barreira*

On 25 February, the Organisation for Joint Armament Cooperation (OCCAR) accepted delivery from the EUROSAM consortium of the last SAMP/T self-propelled medium-range air defence system on behalf of France's DGA and subsequently transferred it to French Air Force. The legwork to officially handover the whole sub-systems, including the support provisions was preceded by activities such as configuration surveys and functional trials.

In 2003, the consortium formed by MBDA and Thales was awarded a contract to deliver 10 SAMP/T systems to replace Thales Crotale and MBDA ASPIC systems and to complement Crotale NG system within the Armée de l'Air.

The SAMP/T, designated in France as Mamba, is operated by ground-based air defence squadrons 01.950 "Crau", 02.950 "Sancerre", 04.950 "Servance", 05.950 "Barois", and 12.950 "Tursan" . Each squadron is composed of two Mamba sections.

Each section is comprised of one ME (Module d'Engagement) engagement module featuring Garofoli's 20ft ISO shelter fitted with Mara computers and Magics II operator consoles VHF and MIDS antennas, datalink interface and radios; one MRI (Module Radar et Identification) identification and radar module consisting of a Daher's shelter equipped with X-band Thales ARABEL (Antenne RAdar à Balayage ÉLectronique) multi-function radar for 360 degree surveillance, detection and tracking with identification friend or foe antena of Selex ES; one MGE (Module de Génération Électrique) shelter-based power supply module with power generating set by Ausonia; four MLT (Module de Lancement Terrestre) vertical launch platforms equipped with Thales PR4G radios, cooling system by SIAG OMC and up to eight launching canisters for Aster 30 Block 1 missiles; and two MRT (Module de Rechargement Terrestre) missile resupply modules; as well as other associated logistics vehicles. All the modules rely on 8x4 Renault Trucks Defense Kerax high-mobility transporters. It was designed to protect the battlefield and critical infrastructure against cruise missiles, manned and unmanned aircraft and tactical ballistic missiles.

The missile features a maximum range of 80 km, speed of more than Mach 4.5, engaging altitude of 20 km, length of 5.20 m and weight of 510 kg. It uses an active radar seeker for terminal guidance. On 23 December 2015 the DGA awarded EUROSAM a contract to develop the Aster 30 Block 1NT missile with first deliveries to France scheduled for 2023.

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Aegis goes down under with Lockheed Martin *Oliver Austin*

Lockheed Martin has begun test and integration of the Aegis combat system on the Royal Australian Navy's air warfare destroyer (AMD) HMAS Hobart.

The 7,000-ton vessel will be the first of several RAN ships to be built around the naval weapon system, which includes a SPY-1D air search radar, a 48-cell Mark 41 Vertical Launch System capable of deploying Raytheon Standard Missile 2s, the RIM-162 Evolved Sea Sparrow Missile (ESSM), and the Harpoon anti-ship missile system for use against surface threats. The advanced capabilities will also include cutting-edge sonar systems and surface-launched torpedoes for specific anti-submarine warfare operations.

Commodore Craig Bourke, the Hobart ADW programme manager, called the development "a significant step towards an increase in the Royal Australian Navy's maritime security capabilities, through the seamless integration of the Aegis combat system, to defend against advanced air, surface and subsurface threats."

"With more than 100 Aegis-equipped ships deployed worldwide, Australia is joining a family of allied nations that continues to push the boundaries of innovation with adaptable and affordable capabilities that meet the warfighter's multi-mission needs."

Lockheed Martin is the Aegis Combat Systems Integrator and engineering agent for the U.S. Navy Aegis destroyers and cruisers, Australian Air Warfare Destroyers, as well as a range of other international customers for both new construction and modernisations. Lockheed Martin also provides the combat system engineering, integration and test for the U.S. Navy's future frigate and Freedom class Littoral Combat Ship programmes.

With more than 40 years of significant investment by the U.S. Navy and its allies, the Aegis Combat System is used globally by five navies (US, Japan, South Korea, Norway, Spain) across seven ship classes, with Lockheed Martin leading the integration effort.

The Hobart-class represents Australia's largest ever defence procurement project, estimated at more than $8bn. HMAS Hobart is due for completion in June 2017, followed by the HMAS Brisbane in September 2018, and the HMAS Sydney in March 2020.

Also in the RAN's ship-building plan are nine new ASW- frigates and 12 new offshore patrol vessels over the next ten years, in addition to life-extension programmes for four mine hunting ships.

The USS Hopper (DDG 70) launching a Standard Missile-3 in the Pacific Ocean. Image: DoD

Stingray replaces US Navy's UCLASS *Joseph Carpenter*

Following a "strategic portfolio review", the US Navy has redrawn its unmanned carrier-launched airborne surveillance and strike (UCLASS) aircraft programme to instead pursue a downscaled capability in the form of an unmanned aerial refuelling platform, coined the MQ-25 Stingray.

> The platform is expected to have limited strike but will have refuelling capabilities aside to an ISR suite

From 2010-2015, the Navy had sought to fulfil UCLASS with input from Lockheed Martin, Boeing, Northrop Grumman and General Atomics, but following contention over whether the platform should be employed as a hunter or a seeker – for airborne penetration strike or long endurance ISR – the Department of Defense announced that it would be overhauling the programme requirements.

The MQ-25, intended as a multi-mission platform, rather than pure reconnaissance and attack, will be under discussion in April as the Pentagon Joint Capabilities Board aims to determine its true needs ahead of the acquisition strategy due this summer. The platform is expected to have limited strike but will have refuelling capabilities aside to an ISR suite. The rethink was described by the Navy's deputy assistant secretary for budget as a "smart approach" that could allow for an incremental development of additional capabilities while reducing the overall financial risk as the programme moves forward. It will employ open standards to encourage future design and integration possibilities once it takes its place in the carrier air wing.

The Navy has requested $89m in research and development funding for the Stingray in its Fiscal Year 2017 budget request, with the total budget targeted at $2.16bn by 2021. It will replace the Boeing F/A-18E/Fs Super Hornets in the aerial tanker role, freeing the multi-role fighter to perform its strike mission, and offer the range and payload capacity associated with high-endurance unmanned aircraft to provide "critically-needed, around-the-clock, sea-based ISR support to the Carrier Strike Group and the Joint Forces Commander.

It is understood that the existing UCLASS bidders will transition their interest in the MQ-25 platform.

An artist's impression of the now 'overhauled' Lockheed Martin UCLASS concept. Image: Lockheed Martin

Fincantieri starts building Logistic Support Ship *Eugenio Po*

A computer generated image of the LSS. Image: Italian Navy

On the 16 February at Fincantieri's shipyard in Castellammare di Stabia (Naples), a ceremony for the first steel cutting of the LSS (Logistic Support Ship) for the Italian Navy was held. The ceremony marked the official starting point of the construction of the fleet scheduled by the Navy renewal plan (known as "Legge Navale" or "Marine Law").

Castellamare shipyard is only building the front part of the vessel while the stern section of the LSS is under construction by Fincantieri's shipyard in Riva Trigoso (Genova). The two parts will be eventually be transported by sea to Fincantieri's shipyard in Muggiano (La Spezia) where they will be assembled together. The delivery of the LSS is expected in 2019.

The LSS will have a displacement of 23,000 tons, a length of 165 m and a width of 24 m and can accommodate up to 200 people. The propulsion system will be CODLAD (Combined Diesel Electric and Diesel) with 2 electric motors (1.5 MW each) and 2 diesel. The electric propulsion will ensure a maximum speed of 10 knots, for higher speeds (up to the maximum speed of 20 knots) the main diesel engines will be used in together with the electrical ones. The ship will have a range of 7,000 nautical miles at 17 knots. The LSS is designed to provide support to a naval group of 4-5 main ships for over 15 days. The ship can carry 6,700 m3 of marine diesel (NATO type F-76), 3,700 m3 of JP-5 and over 800 m3 of fresh water and is equipped with 4 lateral refueling stations (two per side) capable of delivering naval diesel and JP-5 and an with an aft station for the F-76 only.

The ship is able to combine the capability of replenishment at sea for liquids (fuels and water) and solids (spare parts, food and ammunition) and can also perform repair and maintenance operations at sea. The LSS has also a fully equipped hospital with operating rooms, radiology, dental surgery and hospitalisation area can receive up to 12 severe injured. The LSS will be certified by RINA in compliance with international conventions for the prevention of pollution and for the more traditional aspects such as those treated by the MARPOL Convention.

The first steel cut in Castellamare di Stabia shipyard. Image: Fincantieri

General Electric gas turbines picked for Italy's Multipurpose Patrol Ship

Eugenio Po

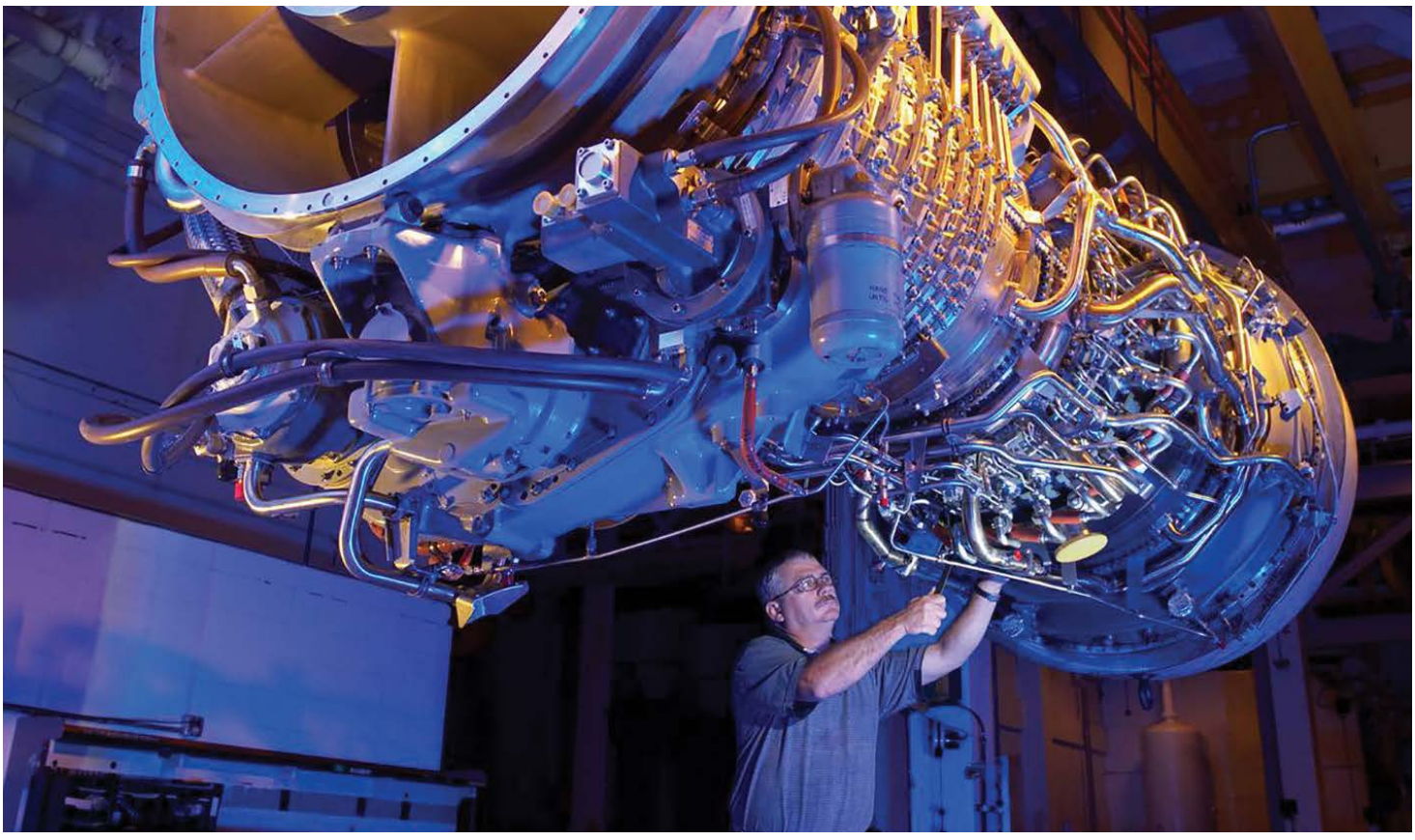
General Electric LM-2500+G4 gas turbines were chosen for the Italian Navy's new Multipurpose Patrol Ships "Pattugliatori Polivalenti d'Altura" (PPA). The LM-2500+G4, which is the same engine installed on Franco-Italian FREMM frigates (Italian BERGAMINI class and French AQUITAINE class), will be one of the key elements of the propulsion system of the vessels. In 2017, the first LM-2500+G4 gas turbine for PPA will be delivered to the Fincantieri shipyard, manufacturer of the new Multipurpose Patrol Ship, while the other six turbines will be delivered by 2022.

For propulsion, PPA has a complex combined diesel and gas or electric system. For reaching top speed of 32 knots the PPA employs the LM-2500+G4 (rated for 32 MW of power) together with two diesel engines, which have 10 MW of power each.

> The Italian Navy is one of the largest users of the GE Marine gas turbine family

Considering the "older" LM-2500 and the new LM-2500+G4, the Italian Navy is one of the largest users of the GE Marine gas turbine family. With these seven engines the total number of LM-2500+G4 acquired by the Italian Navy rises to 17; ten for the FREMM frigates (BERGAMINI class) and seven for the PPA patrol ship.

Avio Aero, part of the General Electric group, is responsible for the design of the gas turbine control system, of the auxiliary systems and of the "base and enclosure" of the entire propulsion system. In Brindisi, Avio Aero has established an advanced maintenance centre for naval gas turbines with over 700 employees. In this newly built structure Avio Aero also produces up to 20 percent of the LM-2500 + G4 components and does the revision of LM-2500 turbines not only for the Italian Navy but also for U.S. Navy engines of some ships. Outside of the US the centre of Brindisi is the largest of its kind for the revision of naval gas turbines.



A technician performs last check on a LM-2500+G4 gas turbine. Image: General Electric

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Hawk trainer support contract awarded to BAE, Babcock, Rolls-Royce

Joseph Carpenter

The UK Ministry of Defence has awarded a $529.52 m (£372 m) in-service support contract to BAE Systems, Rolls-Royce and Babcock International for work and maintenance on the Hawk aircraft. The contract will see the fixed-wing trainer continue to provide a competitive solution for Royal Air Force and Navy pilots for the next five years.

The deal comes a month after the MoD awarded a contract to Ascent Flight Training to provide basic pilot training at RAF Valley until at least 2033

Owing to pressure on the government to minimise costs on defence contracts, the deal will consolidate BAE and Babcock under the same roof and includes provisions for them to assist in upgrading the software on the jets as well as physical equipment. The deal comes a month after the MoD awarded a contract to Ascent Flight Training to provide basic pilot training at RAF Valley until at least 2033.

Of the contract, Rolls-Royce received $113 m (£79 m) to support and maintain the Hawks' 'Adour' engines, with testing taking place at RAF Valley and repair and overhaul activities carried out at facilities in Bristol and Inchinnan, all under the oversight of 40 specialised personnel.

Philip Dunne, Minister for Defence Procurement, who announced the deal in March, stated that it will also secure 675 jobs at BAE and Babcock facilities at Cornwall, Somerset, Yorkshire, Lancashire and Lincolnshire, and in Anglesy, where most of the employees are based.

"The contracts to support these vital training aircraft are a boost to British industry, sustaining hundreds of jobs across the UK –all made possible by our growing defence budget and our £178bn investment in buying and maintaining the best possible kit for our armed forces," Dunne said.

The fleet of Hawk T1s and T2s are the first aircraft trainees fly before graduating to Typhoons or Tornados. They will also be used to train pilots for the incoming F-35 Lightning II. The jets are also used by international forces, including Saudi Arabia and India, serving more than 20,000 pilots worldwide.

British Aerospace Hawk T1 (XX245) from no. 208(R) Sqn RAF. Image: Adrian Pingstone

Romania to receive first new fighter jets in September *Victor M.S. Barreira*

The Romanian Air Force is scheduled to receive an initial batch of six Lockheed Martin F-16 Fighting Falcon combat aircraft in September 2016. The Romanian Government purchased the fighters from Portugal, according to the Peace Carpathian acquisition programme. The remaining aircraft will be delivered mid-2017.

A total of 12 aircraft comprising nine F-16AMs and three F-16BMs previously fielded by the Portuguese Air Force will be transferred to Romania with updated Operational Flight Program (OFP) development software M5.2R.

Along with the updated aircraft, the government-to-government contract also included the overhaul of engines, initial logistics support, training of nine pilots, 75 technicians and four mission planners between 30 September 2014 and 2017, and two years of in-country technical support.

The acquisition of aircraft and associated services was set up according to a €181m ($206m) contract between the Portuguese Ministry of National Defence procurement arm and Romanian state-run import-export Compania Nationala Romtehnica on behalf of the Romanian authorities. To set up the deal, a third-party transfer authorisation was obtained from the US Government. Portugal also paid a foreign military sale (FMS) recoupment to the US.

The new Romanian aircraft will be assigned to 86th air base of Borcea-Fetesti where MiG- 21 LanceR aircraft are currently based. Romania also operates Mig-21 LanceR jets from the 71st Air Base in Câmpia Turzii. The type will stay in service after the F-16AM/BM are inducted, the Romanian Air Force revealed.

To equip its new aircraft, Romania requested the US FMS of embedded global positioning systems/inertial navigation systems, AN/ALQ-131 electronic countermeasure pods, AIM-120C AMRAAM, AIM-9 Sidewinder and AGM-65 Maverick missiles, GBU-12 Enhanced guidance kits and multifunctional information distribution system/ low volume terminals.

The 27 Portuguese aircraft (comprising 24 F-16AM and three F-16BM) are currently updated to M6.1.1 software configuration with new updates planned to be added in line with the country's latest Military Programming Law approved May 2015, including M6.5 software update in 2016. In 2017, Portugal will receive another two F-16AM and one F-16BM aircraft, that are in fact two US surplus F-16A Block 15 and one F-16B Block 15 jets granted by the US Government via the Excess Defense Articles (EDA) scheme in August 2013. The three aircraft are being modernised by OGMA-Indústria Aeronáutica de Portugal.

The Portuguese aircraft are armed with 6-barrel 20mm automatic cannon M61A1 Vulcan; Mk 82, Mk 84 and BLU-109 general-purpose bombs that can be coupled to GBU-12/GBU-49 Enhanced Paveway II, GBU-31(V)1 and GBU-31 (V)3 precision kits respectively; and AGM-65 Maverick, AIM-9Li Sidewinder and AIM-120C5 AMRAAM missiles. Other equipment includes ALQ-131 countermeasure pod and AN/AAQ-28(V) Litening AT Block II targeting pod. Twelve targeting pods will upgraded to Litening G4 standard by Northrop Grumman between 2016 and 2018 according to a direct sale contract worth $22.7m awarded by Portugal in August 2015.

A loaded F-16AM jet being handled jointly by Portuguese and Romanian personnel at Monte Real air force base. Image: Victor M.S. Barreira

Initial Operational Capability for the Italian Air Force's HH-101 CSAR helicopters *Victor M.S. Barreira*

The first Finmeccanica HD (Helicopter Division, formerly AgustaWestland) HH-101A CSAR helicopter of the Italian Air Force has reached Initial Operational Capability (IOC). At the moment the Italian Air Force's 15th Stormo (Group) has a fleet of four machines, with a total of 15 helicopters ordered (under programme CAESAR). The HH-101A CSAR has gained IOC on Slow Mover Interceptor (SMI), MEDEVAC (Medical Evacuation) and utility transport missions.

The HH-101A is the most advanced variant of the AW-101 helicopter and is designed for performing CSAR (Combat Search And Rescue) missions. The machine has a standard crew of five and is able to accommodate up to 20 fully equipped soldiers; for Special Operations and for CSAR the crew can increase to six members while it can transport up to eight SPECOPS soldiers.

The major upgrades introduced on HH-101 are three new turboshafts capable of a maximum continuous power of 2,041 hp each, advanced rotor blades BERP-3 replacing the previous BERP-2 and a new, highly advanced avionics and developed by Finmeccanica HD in collaboration with Rockwell Collins.

The HH-101A is armed with three M-134D 7.62mm Gatling machine guns built by Dillon; two at the side doors and one in the rear ramp with a new type of installation that keeps the ramp available for ascent and descent from the helicopter.

It also includes an in-flight refueling probe, the laser obstacle avoidance system Finmeccanica LOAM, a FLIR Systems Star SAFIRE and a complete self-protection suite. This includes the ELT-572 DIRCM (Direct Infra Red Counter Measures) system integrated with VIRGILIUS ECM/ESM/RWR, both developed by Elt Elettronica.

A loaded F-16AM jet being handled jointly by Portuguese and Romanian personnel at Monte Real air force base. Image: Victor M.S. Barreira

F-35: First transatlantic flight *Eugenio Po*

An Italian Air Force F-35 LIGHTNING II has completed the first ferry flight across the Atlantic, reaching the base of Patuxent River, MA. This was not only the first ferry flight for the Italian Air Force F-35 but the very first ferry for a LIGHTNING II. The aircraft, manufactured in the Italian FACO (Final Assembly and Check Out) of Cameri (Novara) and flown by an Italian pilot, made a stop in the Azores and was escorted by four other Italian Air Force aircrafts: a KC-767A tanker, two C-130J cargo and a Eurofighter TYPHOON fighter, which was on the way to the US for a Red Flag exercise.

The flight was a challenging training experience and was a good opportunity to test the capabilities of the aircraft. For example, during the flight the aircraft was refueled in flight many times with the KC-767A.

Pilot Major Gianmarco "Ninja" Di Loreto coming from Italian Air Force Experimental Unit of Pratica di Mare (Roma), completed his training on the F-35 last fall at Luke AFB and had a total of 50 hours flying time on this type of aircraft.

After completion of the flight this F-35 will conduct three months of electromagnetic compatibility tests at Patuxent River facilities. After that the aircraft will be transferred to Luke AFB, the USAF F-35 "training hub" where other Italian Air Force fighters will be delivered. Later this summer there will be at least five Italian LIGHTNING II fighters there.

The Italian Air Force F-35 during the ferry flight across the Atlantic. Image: Italian MoD

ROTARY WING SPECIAL

MD Helicopters Plans to Hold Steady in the Light Attack Scout Market

Richard de Silva

This year, Andy Pillado, Vice President, Business Development for MD Helicopters, presented a briefing at the 2016 International Military Helicopter Conference (London, United Kingdom) on Multi-Mission Light Scout Attack Helicopter solutions and delivering rapid operational readiness. Pillado discussed the critical role that light scout attack aircraft play in a range of unpredictable operational theatres at a time when there is a real and compelling need for rotorcraft platforms to offer more in the way of faster delivery, expanded capabilities, and a wider range of mission profiles. In response, the MD Helicopters Scout Attack fleet, manufactured by the Mesa, Arizona-based manufacturer, includes the (L - R) MD 530F, MD 530G and MD 540A, all of which offer a key component – flexibility at an affordable price.

In addition to MD Helicopters' expanding fleet of MD 530F Cayuse Warrior helicopters in service with the Afghan Air Force, the company was recently awarded a contract to deliver the more advance MD 530G Light Scout Attack helicopter to Malaysia's Ministry of Defence, Malaysian Army Aviation. Additionally, the company has training, scout and light attack helicopters in service with Saudi Arabia, Japan, El Salvador, Costa Rica, Kenya, and others.

Alongside Craig Kitchen (Chief Commercial Officer), Pillado discussed the company's role in the military helicopter market today with DIB, as well as the strategic game plan for the years ahead…

DIB: Gentlemen, when it comes to light multirole helicopters, where does the need for a solution lie? What are the threats that aircraft like this are intended to counter?

Andrew Pillado: Oh, yes. With the current hours as a basis, we now can give an average cost of US$1,050 per hour.

Craig Kitchen: And that's our major selling point in this global market – the fact that we can rapidly deploy assets. As an example, today when we are shipping products to Afghanistan, we'll build helicopters, have them ready to go, and ship them within six to eight months – in this case because of the urgent requirement in that region. The helicopters will leave our facility and within two weeks they're in combat. They get over there, we reassemble them, flight test them and they're undertaking operations all within that short time. So people are being able to field a weapon system in less than a year at a very good cost. The operational cost going forward is then so low – it's under $1,000 an hour for this helicopter, so it really makes it an affordable asset to bring to the fight.

When engaged in small-scale skirmishes, you have to ask yourself whether you want to deploy a $50m attack helicopter asset or a $5m attack helicopter asset that can really do the same thing for that type of mission? It's easy economics, really.

DIB: Is that a unique selling point, the timeframe to operations?

CK: For the most part, it is. I don't think anybody in the rotor wing business can deploy and build as quickly as we can. We normally quote 12 month lead times on our helicopters but where there's an urgent and compelling need, we're able to move quickly to respond. In this case, the US Army needed to field this system. We went to contract last October. Six months later we delivered six aircraft. Within nine months we delivered 12. In less than 12 months they ➡

An Afghan Air Force MD-530F Cayuse Warrior helicopter fires its two FN M3P .50 Cal machine guns. Image: Staff Sgt. Perry Aston

were fully operational, performing combat operations in theatre. So we have the ability to throttle our production line to meet the needs when they arise.

DIB: What about end user feedback? We've heard discussion today about the need for OEMs to ensure constant communication and properly understand the operational demands, so how do you go about ensuring that that dialogue doesn't break down as is so common when it comes to defence industry matters?

CK: You're right. Our setup is that we offer nose to tail solutions for our aircraft when we ship them. As in Afghanistan, we have partners and teams on the ground maintaining the aircraft. We are in daily 24/7 communication with the support group on the ground and with the customer. You have to have that type of support system in place and just keep at it day in and day out.

AP: Knowing the demands is about listening to the customer. For the militaries throughout the world that we deal with, we go there, they present their problem set, what they're trying to accomplish, what their needs are, and then we design the solution together. We put the capabilities into the platform that they need so that they can be put into effect. It doesn't matter what you're providing, industry needs to listen to the customer. That's why we call talk about our family of helicopters – it's almost a menu for them to choose what capabilities fit their needs. No threat is the same. I agree with everyone when they say the response needs to be overwhelming, but the question is how overwhelming? You still have a cost on the end of it. You can have the most expensive platform in the world but if you can't fly it, you can't afford to fly it, and can't employ it, what good is it? We provide a solution they can take to the fight day to day and that meets affordability and sustainability parameters.

DIB: Being able to cherry-pick a range of solutions is a popular approach, particularly where smaller or more financially-constrained nations are concerned. That brings with it a question of integration…

CK: The way we go about it is that we do all the hard work upfront. There's a range of capabilities that customers want which is why, again, we offer the family of helicopters. When one of these 500s hits the production line, they all look the same. Day one, they roll in, they look the same, and as they get the bits and pieces added to them, the systems are integrated. It may be a (MD 530F) Cayuse Warrior, it may be a 530G, or it may be the next generation we have coming down the line. You can't tell the difference at the start. Once the customer requirements are tabled, it takes on its own shape.

So we do the integration from the start, hand-in-hand with our team mates, whether it's the weapons systems management, night vision, forward looking infrared, whatever it might be. Show me another example where somebody has been able to field an airborne combat system in less than 12 months and put it in a fight. You can't find one ever, anywhere that's gone that fast. It's a very unique solution set.

DIB: But that's not to say it's an easy process, I'm sure.

CK: Well, like I said, all the hard work is upfront. We're working with the user on a continual basis to evolve the upmost system. We look to offer more than one solution for any given requirement – more than one weapon; more than one FLIR capability, and so on. Because we do that work, our customers don't have to. We've found that our customer base is quite diverse and a lot of them have different experiences with different systems and subsystem suppliers. There may be a country we work with that will tell us they don't use a particular system because they've either had a bad experience or because they just have a preference of one over another. We're not trying to offer all things to all people but we are offering a wide range of systems and capabilities so that customers can be certain we're meeting their requirement at an affordable cost.

DIB: You've talked about the success of the past year – what can you tell me about the goals for the next 12 – 24 months? Is it a case of maintaining the pace or are you changing anything about the shape of what and how you provide to this market?

CK: We're staying the course with how we see the market developing. We anticipate that we'll be growing over the next couple of years so that we can meet even more requirements, and so that more folks find their way to us. The more we do, the more people become aware of what we can do for them.

In the longer term we're looking at more evolved systems and at more capable airframes that can do more – carry more, fly longer, farther, faster, those kinds of things. We're currently doing those trade studies and looking at initial designs for things to answer present and emerging threats. For MD, our growth will take us only to a certain point. We're never going to threaten an Apache or a Eurocopter Tiger – that's not our direct competition and that's not where we intend to take our business. We're going to stick to our knitting and continue to address the light attack scout market. We're responding to some requirements from other customers that may or may not include twins, and we're beginning to do trades on those kinds of things as well.

In short, we like this market space. The military market space is what the company was really grown on, with the OH-6 in South East Asia during Vietnam. From that emerged the 500s, 530s, 520s and the 500Cs, Ds, Es, and so on – all an evolution of commercial helicopters. We've now come back full circle in a way, developing a new set of light attack scout helicopters that will result in new law enforcement helicopters and other innovative products for the commercial market.

DIB: And that's not MD pushing that, it's simply the fact that demand and supply for light attack is surging?

CK: There's such a diverse base of customer requirements. Again, you have the Apache and Tiger on one end of the attack spectrum, light attack on the other end of the spectrum, and then everything in-between. There really is quite a difference between the two poles but we're marching up the chain. The guys at the top end of it aren't coming down because it doesn't make sense for them. That said, there's only a certain amount of distance we can travel, only a certain system we can offer and maintain in a cost-effective way. The more complexity you add, the less reliable these platforms tend to get. So our aim is to keep our birds ready to go, to remain reliable, and to maintain our 97 percent operational readiness rate (for three years running) in Afghanistan. It's the highest rate of any fielded system in the US Army, so it's a phenomenal achievement.

We don't want to sacrifice that sort of pedigree. You don't want to find you've left your gun at home and find yourself in a gunfight. If you're in a situation where you need a parachute and you don't have one on you, chances are you're too late to correct the problem. In other words, we have to have a system that's ready to go as soon as you need it to go.

A Philippine Air Force MD-520MG Light Attack Helicopter. Image: Roy Kabanlit

Gearing up for an unfair fight: Bell's Future Vertical Lift seeks to prove its claims Richard de Silva

The US Army is on the cusp of launching a new attack/reconnaissance rotorcraft programme in the form of the Future Vertical Lift (FVL). Two RFIs have been released this year for next-generation rotorcraft technologies and concepts in the lightly armed reconnaissance and mid-size utility/attack roles. The service is looking at replacements for a range of helicopters, including the Sikorsky UH-60 Black Hawk, Boeing AH-64 Apache, Bell OH-58 Kiowa Warrior andCH-47 Chinook replacement.

Bell Helicopter is pitching a third-generation tiltrotor design for the FVL programme, names the V-280 Valor, and has suggested that the design could be ready for other services' helicopter replacement programmes before the Army is ready to award a bid.

Keith Flail, vice president of Global Military Business Development for Bell, told DIB why the FVL is on course to "shock the world"...

DIB: What are the threats that you believe today's armed forces, and particularly helicopter forces, must deal with?

Keith Flail: The threats and operations worldwide are asymmetric and very dispersed. Distance, time, space, speed, range and other factors make a difference when it comes to the responsiveness needed to deal with the threat within any given theatre – especially in the Pacific and Africa where helicopters are faced with a significant challenge because of the tyranny of distance. It's as much about where the threat is as what the threat is. So while we have lots of advanced lethal and non-lethal capabilities to deal with a spectrum of situations around the world, the ability to action those objectives and be in the right place at the right time has to come to the fore.

DIB: Have you been surprised by the shape of the helicopter market in the past year or two? Has there been a big difference with what some see as a major shift in requirements – or has the change of geographic focus significantly impacted the business end?

KF: I think it has. When you look at the peer – or near-peer – adversaries that the U.S. and allied nations are dealing with, I would argue that the service members of all of our respected nations deserve overmatch because they're our most precious resource. We therefore have to make a conscious decision to continue to evolve or even revolutionise in terms of what technology we can provide. That recognition is starting to emerge and is related to the joint multirole effort – the front-end science and technology effort that is informing requirements on reducing risk for the FVL programme. Just from my own observations from 2012 to 2016, the education, the understanding, the technology development, the fact that we're actually designing and building this – it's becoming a reality. We're going to be flying it in 2017. So a lot of eyes have been opened by our ability to take army pilots and decision-makers into the simulator and show them show them everything from the acceleration and deceleration to high- and low-speed agility, and how that can impact TTPs.

> There's a huge misconception about affordability and cost for what we're aiming to do with the tiltrotor

DIB: While it may be the right fit for the United States, there have been some questions aired these past few months about whether this really is the future of helicopters for the global market. Royal Netherlands Air Force (RNLAF) commander Lt. Gen. Alexander Schnitger voiced concerns that he is not "convinced that the current plans are advanced enough to survive use past 2030." Others have suggested that the specific national requirements for smaller forces may not call for such a high-end platform. How do you address that?

KF: I'm glad we're having this discussion because I think there's a huge misconception about affordability and cost for what we're aiming to do with the tiltrotor. If you look at the V-22, you have to look at the right metrics. You have to look at the productivity of your asset. You have to look at cost per seat mile. You actually have to look at what you're ultimately getting out of that asset. If you draw two rings for how far you can range with a tiltrotor, you find you that with tiltrotors in the centre of Afghanistan you can range the entire country.

You don't need FOBs and you don't need field hospitals. You'd be putting a smaller ring inside there for what you'd be getting with conventional helicopters. So when we talk about affordability, you have to look at everything – R&D costs, procurement costs, operational costs, and then you have to look at the productivity you're getting out of that asset, including the effect on logistics. You can remove all these things because you don't need them anymore. I think that's been something that's been overlooked in the last couple of years with the joint multirole effort, with our government counterparts, we've actually received comments back that we're seeing and learning things out of this science and technology effort that we didn't anticipate we would be getting, in terms of advanced digital tools, embedding all of our teammates in the same virtual environment, so you can design faster. You can put the government in that same environment, you can iterate on design changes, rather than having to go with the traditional methods.

So all that cycle time is another thing that relates to affordability. When people talk about affordability, you need to look at it holistically. There's a lot of short-sightedness. Number one, on what a V-22 costs versus what a V-280 is going to cost (and they're a different scale of aircraft). The V-22 is an incredible platform with an incredible capability but what does it mean downstream in terms of all those other costs? Either way, you can talk austerity of budgets, but you still have x number of dollars or whatever your national currency, you still have to pay for all those things. You're only looking at the front-end, at the cost to buy the platform, but not the additional procurement costs or operational support costs or system lifecycle costs. That's where you're impacting your bottom line. With the V-280, we're targeting a price point comparable to an Echo-model Apache or Special Mission Blackhawk. And we're tracking that.

DIB: As we speak, where are you exactly with development?

KF: We're now essentially through the detail design phase and heavily into the build of the aircraft. The fuselage is completed; we're mating the nacelles to the wing within the next month, and then within a month later we'll be mating the wing and nacelle to the fuselage; then we'll begin to fit the aircraft with all the systems, building up all our gearboxes – we have our systems integration lab, we have our cockpit rig, our electrical benches, our flight control software, avionics, a rig room that has all of our hardware in the loop for all of our actuators to prove out all of our controllers in the systems integration lab before it gets to the aircraft. All that activity is going on now. By the end of 2016, the aircraft will be completely built up with the exception of the rotor installation. This is unit number one of a demonstrator, so providing all that data of the simplicity in design for manufacturing, affordability and maintainability, to give the government all that data – concrete actuals, videotaping everything we're doing, so that we can show the accuracy of our work. Unfortunately, in the past, we've heard the stories before from other programmes – that this platform is going to be more affordable than the last – well, we're providing the proof. Everything about the aircraft – the processes, the materials, the advanced digital tools, the way the aircraft fits together – the fuselage itself that came from Spirit AeroSystems…there's only three hard chines on the entire aircraft, so literally everything fits together like Legos. When you look at that design for manufacturing, you're removing a lot of potential rework, reducing the potential costs such as additional holes you have to drill, because we're using a lot of composites – all those things add up to a more affordable platform, it's cheaper to build and get into the flight test programme in 2017 to show that it performs and operates like it should. It's all about providing the proof which we're one hundred percent focused on.

The V-22 Osprey has been praised for its ability to access disaster-hit regions. Image: USAF

Right now, we're beating all the metrics the Marine Corps has established for cost per flight hour and maintenance man-hours per flight hour

DIB: Which presumably answers the question from some about the risks of FVL becoming similar to the Joint Strike Fighter programme and it's notoriously spiralling costs...

KF: We're providing flexibility as well as all this affordability data. At a recent Army Association of America event, we set up a full-scale model. One day we demonstrated it in terms of utility. The next day we demonstrated how it would configure with weapons. The next day, how it would configure with MEDEVAC. Even though it was a model, that reconfigurable central cabin area was the same as in the real design. So I don't understand how this could be comparable to the JSF situation. We look at it from the standpoint of our Marine Corps and how satisfied they are with the commonality between the H-1 programme between the Yankee and the Zulu – they're 85 percent common – and right now, we're beating all the metrics the Marine Corps has established for cost per flight hour and maintenance man-hours per flight hour. We leverage the V-22 experience and the H-1 experience on commonality, applying that to the V-280.

The bottom line is that when this thing flies, it's going to shock the world. I'm not trying to be dramatic – it will. Once you've addressed every capability gap, you've reached the affordability and agility required, why would you not want something at a comparable price point, a comparable physical footprint, and that has twice the capability? It comes down to overmatch. The world is not a safe place and we owe it to our service members to provide them with this.

Concept image of the V-280 Valor. Image: Bell

The Briefing Room

"Many Middle Eastern countries have expressed increased interest in Russian military hardware..."

Nikolai Ruban is confident in more Middle Eastern exports. Image: Georg Mader

In the wake of Russia's 'fall out' with the West over its intervention in Ukraine since 2014, Moscow's state-run arms export agency ROSOBORONEXPORT has been targeting new arms export markets as part of a larger Kremlin policy to turn away from the West and towards the East. At the Bahrain International Airshow (BIAS) 2016 at Sakhir Air Base this past January, DIB correspondent Georg Mader discussed this 'pivot' with the agency's regional manager and head of analysis and planning, Mr. Nikolai V. Ruban, PhD.

DIB: Russia globally leads with a 3% share of arms exports among total exported goods. SIPRI says Russian arms exports in the years 2014 and 2015 were substantially lower than in 2011, 2012 and 2013, and more in line with the levels seen between 2006 and 2010. So to give us an idea of magnitude, what are ROSOBORONEXPORT's current portfolios and their approximate value?

Ruban: In basic figures those numbers may be right. Nevertheless, we are defending our No.2 rank behind the USM, with ROSOBORONEXPORT holding a 85%+ share of Russia's military exports and an orderbook of (USD) $45bn at present. Among that, the order portfolio for aviation equipment currently exceeds $22bn and the one for ground based air defence technology stands at $9bn. And it continues to grow. In 2015 – which is not yet fully calculated – we have received fresh foreign orders worth $18bn. It's not only classic armament, but also a wide range of products for urban security, counterterrorism, facility protection, border protection and natural disaster clean-up. For 2016 we expect the same global demand for Russian defence products.

DIB: What is the demand here in the Middle East?

Ruban: Our agency is negotiating a series of contracts with Egypt, Syria, Iraq, Lebanon and Algeria. The Arab world accounts for 37% of Russian arms exports. We, as ROSOBORONEXPORT, part of the ROSTEC State Corporation, are here to primarily discuss the prospects for deliveries of Russian aviation equipment to the region. Many Middle Eastern and North African countries have expressed increased interest in Russian military hardware, with significant interest grow expressed in combat planes and combat helicopters, military transport aircraft and trainers, and of course different types of ground based air defence systems. Regarding the latter, Russia is holding talks with Egypt on the delivery of 'Antey-2500' anti-ballistic missile system and 'Buk' surface-to-air missile systems. But interest is also received on Russian wheeled and tracked armored IFV-vehicles, already in use in the region and proven in combat.

> Algeria ordered 14 Sukhoi Su-30 fighters from IRKUT Aircraft Corporation. Deliveries will begin later this year

DIB: Who, for example, is using modern Russian IFVs?

Ruban: The UAE Army, for one. Several hundreds of them have already been used in combat in Yemen, from what I hear. Last year we also completed the fulfilment of the contract to supply 200 BMP-3M and BMP-3K IFVs to Kuwait. The last batch of the vehicles arrived in Kuwait in early November and are currently undergoing the receipt and acceptance process. A number of Middle Eastern countries also expressed their wish to buy the Russian T-90 MBTs.

The Briefing Room

DIB: Can you confirm a fresh contract with Algeria on more Su-30MKs, or even one for the Su-34 strike-bomber?

Ruban: In September 2015, Algeria ordered 14 Sukhoi Su-30 fighters from IRKUT Aircraft Corporation. Deliveries will begin later this year and will be completed by late 2017 or early 2018. They already have 44 from before 2010. Regarding the Su-32 – the export-designation of the strike-aircraft Su-34 – I only can confirm that they want it. The related talks are ongoing and have reached an advanced stage. Previously, these aircraft did not have an export certificate, but the appropriate documents were obtained in late 2015. So I am hoping the contract for an initial batch of 12 or 14 will be signed between the Algerian Ministry of Defence and manufacturer NAPO (Novosibirsk Aircraft Production Association) by mid-2016. Definitely by the end of the year. There is a mutual interest in the deal.

The current fleet of Soviet- and Russian-produced civil and military helicopters in Middle Eastern countries numbers more than 500.

DIB: What do you expect here in Bahrain?

Rostervol Mi-17 production facility. Image: Georg Mader

Ruban: We have come here – along with ROSTEC subsidiary companies 'Russian Helicopters' and 'United Aircraft Corporation', and 'Ilyushin Finance' – because at the last Russian International Aviation and Space Salon MAKS in Zhukovsky, his Excellency Engineer Kamal bin Ahmed Mohammed (Minister of Transportation and Telecommunications for the Kingdom of Bahrain and Deputy Chairman of the Supreme Organising Committee for BIAS) signed an agreement to do so, in the push for both our countries to benefit from cooperation with Russia and the GCC. The Bahrain Government is committed to building stronger ties with Russia. Last July, a delegation from here visited Russia to observe the 2015 'Aviadarts' international military aviation competition, which featured Mi-35, Mi-8 and Ka-52 helicopters, as well as fighters like the SU-30 and Su-34. Russian manufacturers have, by the way, participated here at BIAS since the inaugural event in 2010 and we are delighted to see a continued presence established. This time our delegation is represented by the Russian Air & Space-Force Deputy Commander-in-Chief, Lt. Gen. Sergey Dronov.

DIB: But are concrete steps being made in the defence-industrial sector?

Ruban: Yes. Moscow and Manama are eager to broaden their military-technical cooperation. In May of last year, Russia and Bahrain signed an agreement on military cooperation during a visit of the head of the Russian Federal Service for Military-Technical Cooperation (FSMTC) to the Kingdom. Russia has similar agreements with other Gulf states, including Saudi Arabia, Kuwait and the UAE. Talks between FSMTC's head, ROSOBORONEXPORT, and the Bahraini side were fruitful and we expect further extension of cooperation in the military-technical sphere. The foundation is already in place. You may remember back in 2011, when the Bahraini Forces (BDF) had a sudden break in supplies [because U.K. and France banned some weapons sales to Bahrain following its crackdown on protestors], the BDF subsequently ordered Russian small arms like AK103, with grenade-launchers and ammunition. Since then, Bahrain also has become the first customer for the 'Kornet-EM' anti-tank missile. And when yesterday the King of Bahrain, Hamad bin Isa Al Khalifa, visited the Russian chalets and exhibitions, he expressed interest in Russia's 5th Generation multirole fighter-complex, Sukhoi T-50.Colombia is currently looking to replace their fleet of Cessna A-37 'Dragonflies' and with a similar aircraft. ➡

The Briefing Room

A Su-34 in Syria with dumb bombs. Image: Georg Mader

DIB: Will PAK FA be exported anywhere besides India? And if so, when?

Ruban: Later on, it can be. A serial production of an export version is scheduled for 2020, while today the eleventh and last of the T-50 pre-series is about 60-70 % ready.

DIB: What types of aircraft and helicopters did you market or push for here at Bahrain?

Ruban: The Su-35 and MiG-29M/M2 multirole fighters, Yak-130 combat trainer, Il-76MD-90A military transport, Ka-52 and Mi-28NE attack helicopters, Mi-35M transport/attack helicopter and Mi-171A2 type military transport helicopters. They have great export potential in the region.

We also present the ANSAT, Ka-32A11VS and Ka-226T. A key area in negotiations will be the development of an integrated system of aftersales equipment service for the lifespan of helicopters. The current fleet of

> You often don't need this expensive high-precision munition for these terrorists all the time, these thugs in their Toyotas

Soviet- and Russian-produced civil and military helicopters in Middle Eastern countries numbers more than 500. The ability to carry out maintenance and repair work in the region will allow operators to significantly reduce costs. This is why interest from foreign customers, including in the Middle East and North Africa, is growing. This stems from both launching new aircraft models to the international market and high operational effectiveness of modern Russian military aircraft, including its capabilities for delivering surgical strikes on ground targets. Demand is supported by an excellent cost-effectiveness ratio and Russia's reputation as a reliable and responsible partner in military-technical cooperation. That's what we have to constantly try to remain competitive.

DIB: You talk about 'surgical strikes' on ground targets, but why do we then see quite modern Su-34 among the Russian air forces in Syria carrying four or six 'dumb' and old bombs? Are those precision weapons just for MAKS or exports, or are there not enough to outfit the Russian VKS regiments?

Ruban: Yes, of course they are available – if the military commander requests them. GLONASS-guided KAB-bombs, for example. But you often don't need this expensive high-precision munition for these terrorists all the time, these thugs in their Toyotas.

The Briefing Room

DIB: Yes, your doctrines have more of a…'kinetic' approach. Western air arms however do not even have those FAB and OFAB and SBU equivalents in their inventory. Do you advertise Russian technology in the fight on terrorism here?

BA: We do. Where else, if not in this region. At the exhibition, ROSOBORONEXPORT held the open presentation "Russian Military Aircraft Fighting against Terrorism," which analyses the Russian fixed-wing and rotary capabilities for use in counterterrorist operations. Russian efforts throughout the region will pay off, because of lower cost and reliability of Russian military hardware. I would not name it a 'showcase' because it is a clear execution of policy by our government and leadership, but Russian systems and their use are literally on display in Syria. Everyone can see their capability and availability.

DIB: At Dubai 2015 there were reports on a significant interest in Russia's Mi-35 combat helicopters, with Bahrain and Pakistan among the Air Forces reportedly looking to add the aircraft to their inventory. What news has there been on this?

BA: I can confirm that we have signed a contract with Pakistan for the Mi-35, with deliveries to begin this year. The Royal Bahraini Air Force [RBAF] has also expressed strong interest in the Mi-35, the latest export version of the 'classic' Mi-24 helicopter. They received an exhaustive consultation-briefing about the technical characteristics and military use of that helicopter, in several versions, which is currently in service in more than 30 nations, including Brazil, India, Venezuela, and in the new Iraq.

The King of Bahrain tried out the view from a Sukhoi cockpit. Image: Georg Mader

Interview: Thomas M. McLaughlin, CEO of Motion Reality Inc. Making virtual reality training for the military a...reality *Rory Jackson*

The first ever Abu Dhabi Aerospace and Aviation Week, held in March 2016, saw cutting edge technologies from multiple industries displayed for defence and security agencies from around the world. Given the importance of keeping pilots trained and ready for any situation, it was only natural to find a dedicated simulation and training zone within one of the show's many halls.

It was here that Atlanta, Georgia-based Motion Reality Inc. had set up a fully-sized demonstration display of their state-of-the-art Virtual Reality (VR) training solution, the Dauntless system, for their newest customers in the United Arab Emirates, and prospective buyers from military and police forces worldwide. *Defence Industry Bulletin* sat down with Thomas M. McLaughlin, CEO of Motion Reality, to discuss the technology and history behind their unique platform

DIB: I understand that Motion Reality has been working with graphics engines and software for decades now. When did the idea first arrive to start applying your technology to military and police training scenarios?

TM: It first started in the mid-90s. We were working since 1990 to put the first humans into both video games and motion pictures, working with Acclaim Entertainment on games like Mortal Kombat and Alien Trilogy and Turok and many, many others. Starting in the mid-90s, the U.S. Army actually approached us for putting the first soldiers into virtual reality simulation training. We put the first head-mounted display on a non-pilot; up to that point, every head-mounted display had been on pilots sitting on chairs with a cable attached. So the concept of having people actually run and move around with the headset on was very unique. About 99 percent of all the money ever spent on simulators has been for pilots - and yet about the same percentage of the deaths and injuries in all of our wars, worldwide, have been the people on the ground. So essentially, this is a simulator for everyone else.

DIB: But a great deal of technological advancement must have been necessary to get to where you are now - to the Dauntless system?

TM: In the 90s we proved that we could put two soldiers at a time into virtual battles for training. But the technology wasn't quite where it needed to be at the time. And although we've made great progress, and we were being positioned to train all our forces, when 9/11 happened all the priorities changed very drastically. So when the funding priorities of the army changed to deal with the new threats, Motion Reality began the work to create a next-generation simulator for squad-based training, up to 12 people, which would handle the biggest squads in the US, the Marines. We developed and launched our first military and police simulator in 2008, and at the I/ITSEC conference in Orlando that year, the FBI was the first one to immediately order a system for training all the agents at Quantico. Now it did take several years, they wanted it to be IN the Quantico schoolhouse, and so it took several years for them to find the space and renovate an old boiler room - but it's been in there, training agents since 2011.

DIB: And recent months have seen the system gain international recognition.

TM: I/ITSEC was where we launched VIRTSIM eight years ago, and we just showed in December last year the first Dauntless system at a trade show, and here at UMEX in Abu Dhabi is the first international showing of Dauntless. When the sequester happened, in 2010 we started getting orders from around the world and we're very pleased that the very first foreign client was the United Arab Emirates - Presidential Guard Command - and we have had several systems in the UAE Presidential Guard training their forces from their National Service, all the way up through their Special Operations since around 2011. In addition to that, many guests of the UAE use the system for training Special Forces of many other nations, which includes the US. So we've now done tens of thousands of soldiers, we've also helped train U.S. Homeland Security on several projects, and police and army and special forces from around the world - arguably more people than any company in virtual reality training environments.

DIB: But what Motion Reality has created differs hugely from present simulator systems, doesn't it?

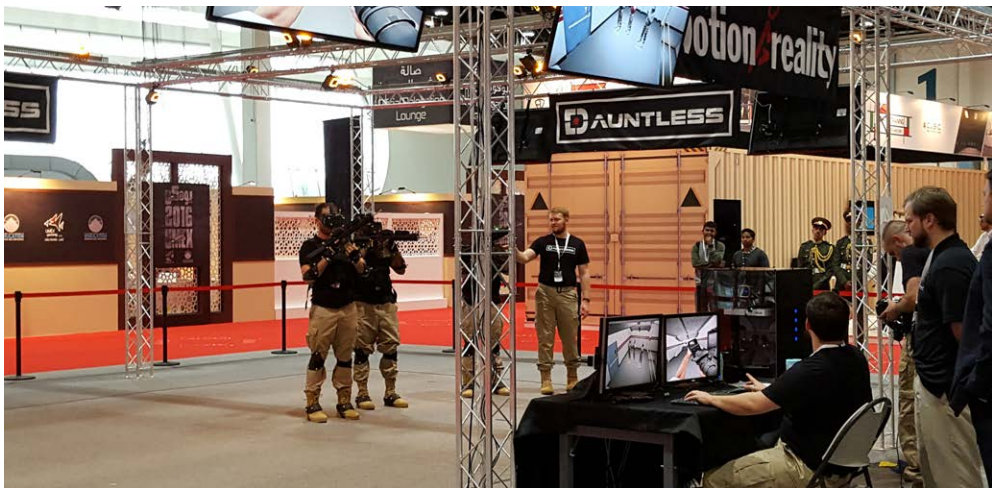
TM: What's unique about our system versus other simulators is that in almost every other simulator, you are typically a passive observer of what's on-screen. They could be all around you, they could be in front of you, they could be on a laptop, or you could be shooting lasers at videos on screens. However, you are not actively engaged in that environment. In our world, we put you as a truly immersed, active participant in a 360-degree battle, and there are no encumbrances, no cables, there aren't any joysticks or controllers or treadmills, or any artificial devices, which have been proven by independent studies to be ineffective in training people. We as humans need to move naturally, and if you're going to train people to fight, they need to train the way they are going to fight. If it's artificial, under stress they revert back to the way they trained, and that can cause injuries and death.

DIB: How deep does this 'immersion' run?

TM: So we have tried to make it as close to the real thing - to have all of the impact of a real training exercise to be as close as possible to the real battle. For example, there is sensory feedback that basically allows the closest thing to being shot to occur. To take it from being just a game, there has to be consequences when you do something wrong. When somebody shoots you in the Dauntless system, live or artificial, you will get an immediate and powerful muscle-stimulation that will definitely get your attention.

DIB: And these are within the gear they wear as part of the training programme?

TM: And in the part of the body that gets hit! We have put what is essentially a TENS unit for muscle stimulation-rehabilitation that we have on different parts of the body. If you get hit on, say, your upper quadrant, or your right arm, you will get this very strong feedback. And we can make it different levels of intensity now on Dauntless, we can leave it on for ten minutes or whatever, so you have to learn how to deal with the pain and not being able to move your arm. You have to learn how to stay in the fight and stay alive. It's much more realistic than anything else. Stephen Hawking said about our technology in his international TV series 'Brave New World' last year, this is the closest thing to being actually shot at. And you do not know how people respond in training until they are shot at.



Three Motion Reality employees demonstrate the equipment, as engineers and onlookers observe the simulation through display monitors. Image: Rory Jackson

What Dauntless shows is a result of about three years work by a very talented team of interdisciplinary scientists that we have from every branch of engineering, computer programming, 3D animators army and FBI veterans that give us feedback and training input into what we should build. And many very talented people working together. In the last three years we've integrated in a world-leading graphics engine and we have also added significant new software features that our clients have asked for that we couldn't do in the previous generation.

DIB: To what extent can trainees interact with the environment, in context of the rooms and situations they're in?

TM: We now have things like physics objects. So you can literally touch objects and they respond. You can knock things off a table that aren't even there. You can have dynamic shadows. You can have any time of night or day, it can be created to train in. Most importantly you can create geo-specific areas for mission training before you actually go out and do a mission, for mission-specific training.

DIB: And does the philosophy of realism extend to simulations of the real world?

TM: You can create an area of a city, for example, with imagery from satellite and other sources. And actually have your forces train in that environment before they go out and do the real thing. And even have them train in the time of day that they'll be going out and doing the mission. We've added all sorts of visual features that include things like explosions, night vision, dynamic flashlights on the weapons…

DIB: Including low-visibility conditions like fog and dust?

The Briefing Room

TM: Particle physics, we call them. And bullets will go through things they're supposed to, but not through things they're not supposed to. We actually have very powerful electronic recoil and realism in our weapons, we have M4 rifles, we have Sig Sauer handguns, and they are as real as anything that they use in the real world. We are also custom-building other weapons for our clients; we even count the number of shots that you take, and then we electronically jam the weapons when you run out of rounds so you have to actually put another magazine to continue firing. We can also jam a weapon if we decide we want to see how a trainee performs under stress.

DIB: Given the nature of the simulation zone - it is a wide, flat area - how can the system account for situations with varying elevation? Combat situations will not always take place on a single level - storming multi-storey buildings or dealing with height differences in outdoor skirmishes, for example.

TM: We have patents on quite a few new features now, for Dauntless - when you walk through a stairway, you start - going up - the virtual stairways. You know where all parts of your body are, so we actually track where your feet are when they get near a virtual stairway, you walk on the flat ground but you are literally, seamlessly, walking up stairs. And fighting up and down stairs. We also have another new patent on what's called '3D directional sounds'. Wherever you are in the virtual world, it may not be where you are in the physical world, you could be standing right next to each other in the physical system, but yet you could be in blocks a mile away, and when there's an explosion, or shots taken, or a missile, you will each hear things accurately from your own three-dimensional locations. We have many, many other features - basically, water, and beaches, you can get on a bench and it becomes a Blackhawk helicopter that takes off, you can shoot and be shot at accurately as you're flying in things like helicopters. A bench becomes - a vehicle. You're not limited - it truly is unlimited potential for any kind of training.

> We have artificially intelligent avatars that have different levels of shooting accuracy and responses to what you do

DIB: What about the opponents that trainees will face? Enemy combatants can be far more unpredictable than environments.

TM: We have artificially intelligent avatars that have different levels of shooting accuracy and responses to what you do, but in addition you can have tactical team leaders and training officers become what we call 'virtual role-players', where they can become - and look like - any bad guy, and get in with the artificial intelligent characters, and do many more challenging things to the trainees than you could ever programme. They can play an infinite number of roles. And we've actually been asked to create a lot of sensitive buildings. For example, for the first time, we can create photo-realistic training environments that can't be trained in. Nuclear plants, something like the White House for example, embassies, presidential compounds, and so on. Forces can train in these areas, knowing all the dimensions are the same, with the new generation of graphics. They can be much better prepared by training in exactly the worlds that they may someday have to protect, when something - God forbid - happens.

DIB: And even manually-constructed training villages may be made obsolete by Dauntless. Would you agree?

TM: We have been proven to be more cost-effective and more quickly-usable, and we never get old. Building physical infrastructure, shoot houses, and training villages, and so on...once you've been through that one time, you know where everything is. In our world, it's not only constantly changeable for the future, with an unlimited number of training scenarios and environments in different parts of the world, but, unlike video simulators, we can immediately, in a few seconds, change where things are. Change walls. Move people. So the next group in line actually goes into a totally different situation. It can be modified fast, so it's always unlimited.

DIB: What provisions has the system integrated for post-exercise review? To point out to trainees where they need improvement?

TM: A new feature we have, unlike every other simulator where you have some very elementary information - typically just a couple video views, some simple ideas which were shot on a screen - we have the most powerful 3D after-action view ever. All of the engineering physics, all of the data, of how every single trainee moved, every shot taken, the time instance of every shot, who shot who, who was hit, what part of the body was hit, what was the 3D trajectory... We can show all of that graphically. We keep track of everything in a database. You can make hits-and-misses reports. It's like a 3D VCR ➡

or DVR. You've got every conceivable view; you can look through every single person's eyes and see what they saw - you can evaluate every technique of every trainee - and our training officers around the world call this our 'No-Alibi System'. Because no training officer can ever see what every trainee does on any kind of a training exercise. You just can't see what everybody does. Very often a trainee will say "Yes sir, I looked behind that couch in clearing that room." In our world, we can play back every single thing, look through everybody's eyes - we actually have the ability to see where they looked, to be able to identify, did they actually look there? A lot of times, the trainees don't even know that they didn't look behind something! Or they don't know, they don't remember what they really did! So they can see and quantify every single detail, what every person does. And it's often very valuable to have - to give them the eye-view of the bad guys! They can see: "Oh my gosh, I gave away - I leaned forward around that corner, and gave away my position! I'd be dead if he'd really shot me!" The after-action view has all the data stored in an automatic meta-database. People can be evaluated and quantified for their progress over time. You can come back a year later and see how they're doing now. It's the best way to certify that you are training for forces, for police and military, in the best possible way.

DIB: One last question: what is the largest training space you've constructed, or might expect to construct for the Dauntless system? I understand you generally provide for close quarter combat demands, but out of curiosity...?

TM: Yes, we have three clients that very much want us to create football-field-sized systems.

DIB: As if to simulate multiple city blocks!

TM: Yes. Our biggest system right now is a basketball court sized system. So it's a hundred feet by fifty feet, or roughly thirty-three metres by seventeen metres. Now, we are not limited by that size - in our motion picture business, we've done much bigger things than that over the years. However, there's no reason technically why we can't create a football sized system. It's just that right now the wireless limitations - because we need high-speed wireless to keep up with the very high speed rates to the eyes for our VR headsets and the computers on the back. It's wireless constraints that nobody in the world has the ability to overcome. But as soon as we begin to work out a way to do that, we will be creating football-field sized systems.

We have three clients that very much want us to create football-field-sized systems.

Interview: James Thompson and Robert Walker, General Atomics

Rory Jackson

Robert Walker (left), Jim Thomson (right), General Atomics Aeronautical Systems. Image: Rory Jackson

The second Unmanned Systems Conference and Exhibition was held as part of the first Abu Dhabi Aerospace and Aviation Week. *Defence Industry Bulletin* took the opportunity to speak with **James "Jim" Thompson, General Atomics' Regional Vice President** in charge of international strategic development for the Middle East and North Africa. *DIB* also spoke to **Robert Walker, Director of Strategic Development,** on the development of the company's latest platform, the Predator XP, and on the work being carried out on the Predator B to conform to STANAG 4671 - the NATO Airworthiness Standard for RPA systems - on lightning and bird strike protection, non-destructive testing, and advanced composite and adhesive materials for extreme environments.

DIB: I understand the Predator XP is based on the original RQ-1A, and will be delivered to the UAE later this year?

JT: RQ-1A first flew in operation in Bosnia in 1995. It really was a game-changer in the world of unmanned air systems; prior to the Predator, RPAs - remotely piloted aircraft - were not known for their reliability. And they were basically flying on a line-of-sight datalink, which limited them to maybe, 100-120 miles from their point of take-off. So they had limited utility. General Atomics, with the Predator, put a satellite control datalink in it, and that enabled you to go much further, because the aircraft itself at that time is flying for up to 25 hours. And the reliability was greatly increased. That system flew successfully - it's still flying today. But it's no longer being produced. The U.S. Air Force, our primary customer for the Predator RQ-1 - which of course, then, became the MQ-1 - stopped their procurement in about 2011, or 2010, when they bought the last one.

DIB: Why did they cease procurement of the platform?

JT: Well, they were buying our larger Predator B at the time. And they had been splitting their orders between the two; they decided to put all their money in one basket and go with the Predator B. A lot of reasons why. Number One – obsolescence; you're better off investing in one platform. Well, the timing of that actually was very good for us, because we had been working on getting approval of the Predator XP for sales in this region. And that happened at about the same time, 2010-2011. And when we shut down the production for the U.S. Air Force, that left all this capability - the composite, moulds, everything, the salinoids that we had set up for twenty years, we were able to apply it to the Predator XP. We didn't have to lay anybody off or shut anything down.

DIB: And so, with the Predator XP, General Atomics took the opportunity to begin making improvements?

JT: We took the opportunity to completely redesign the aircraft from the ground up, in terms of improvements. We were limited by having the one customer being the U.S. Air Force, where, it really was 'their design'. We couldn't make a change - if we thought something could be improved upon, we could make a recommendations to the U.S. Air Force, but they didn't want to make it a part of the programme of record, and then we weren't allowed to change it. And so, the engineers at General Atomics had a long list of improvements that they wanted to make to the Predator that were limited until the Predator XP arrived - and everything, all of a sudden, came out of the woodwork.

DIB: What systems and components has the XP retained?

JT: We retained the power plant and the datalinks that were proven, robust - so we kept the Rotax 914 engine, but we improved the cooling capability for it. Especially for operating in these areas. And the datalink, the loss-link ➡

software - which is very important if you lose your link, proven over two million flight hours, airplane comes home on its own, you retain the link and you land - all that stayed. Some of the other areas that we kept included the radios, which is another very important part of the aircraft. We didn't change out the radios; the communications links all stayed the same.

DIB: How about improvements to the subsystems? Given the technological advancements and changes in conventions since the late 90s, which other systems has General Atomics been able to take advantage of?

JT: We looked at our other aircraft, which is the U.S. Army Grey Eagle and the Predator B for the U.S. Air Force, and we had put in triple-redundant avionics in those aircraft. The original Predator was single-string, so you basically had one of everything - if that one failed, then you could have some problems. Very reliable system, but nonetheless, our new aircraft had triple-redundant avionics so, if you had one fail, the other two will carry you home. We took that, and put it into the Predator XP.

> We extended the wing length by about a metre, added the winglets, and that gave us quite a bit more endurance. Five percent more.

DIB: The shape of the airframe has also visibly changed between the RQ-1A and the XP, has it not?

JT: We redesigned the tails, and made them a fixed-tail configuration, dual-redundant. So if you had one of your ailerons on the tail lock up or freeze, it didn't make the airplane unflyable because each one has two. We added automatic take-off and landing capability to the system, which came out of our U.S. Army Grey Eagle aircraft. Very important point: we added dual sensor capability. The original Predator only had the ability to carry an EO/IR camera. All of our other aircraft since that time also had a wide-area search radar system, called the Lynx radar, which General Atomics produces. It's capable of Synthetic Aperture Radar (SAR) imaging, Ground Moving Target Indicator (GMTI); it even has a mode for maritime tracking. So the Predator XP has dual payloads. We added new winglets on the wings - the original Predator did not have those. We extended the wing length by about a metre, added the winglets, and that gave us quite a bit more endurance. Five percent more.

DIB: So the winglets also contribute to the increased range of the aircraft?

JT: Yes. And they also work very well - we moved our antennas for the radio, the UHF, VHF, and we also have Automatic Identification System (AIS), which is a means of tracking ships - we put those in the winglets, which takes it away from the main body of the aircraft where we have a lot of electrical interference. It puts them out as far as you can from the main body of the aircraft. As you can see from our model, we have LED lights as well on those winglets. We even changed out the propeller. We did a design study on the propeller, we had about four or five different models built, ran them in wind tunnels for hours and hours on end to see which one was more efficient. The aircraft resembles the original RQ-1/MQ-1 Predator from the outside, because we retained the basic aerodynamic shape, but it's actually fully designed, it's our newest aircraft, it really is. Even though it's based on the oldest aircraft, it's now our newest aircraft.

DIB: And a full range of modern sensor options are available to operators?

JT: As far as the sensors go, we have an EO/IR, we can use WESCAM's, FLIR's, Raytheon's... they all offer HD EO/IR capability; laser pointers, laser illuminators, range finders, truly amazing sensors. So you think back to the old days of 1994, you had an analogue system on there: a 14 inch gimbal. We've now gone up to almost a 16 inch size gimbal. So there's been tremendous improvements in EO/IR camera systems.

DIB: UAVs are never static; development, as I understand it, is always ongoing, to keep systems up-to-date with all the capabilities modern technology offers, and to keep offering something new that competitors cannot. Can you share any details about what's in the woodwork for the Predator right now?

JT: The one we're working on today is a Traffic Collision Avoidance System (TCAS) for sense-and-avoid. It's not integrated in what we're delivering today, but it's something we're working on back at the factory. A lot of our customers - especially in this region where countries tend to be small and they don't have a lot of segregation between the military and their commercial aviation. And right here, in the UAE, Al Bateen base is a multi-use military and commercial base. You go to Bahrain, Kuwait, Qatar - they're all very small countries, and there's really not a separation. They fly their military aircraft the same place they fly their commercial craft. So we're working on integrating a TCAS: we have transponders on the aircraft currently, the TCAS will help greatly. It's something we hope to have available in our systems in the next year or so.

DIB: How long has GA been working on its TCAS?

JT: TCAS systems are in existence today - many aircraft, manned aircraft, have TCAS systems on board. We're not developing it, we are integrated an existing TCAS onto our aircraft. I don't know who the OEM is for that system, but we're integrating it onto the Predator XP. But the Due Regard radar is a General Atomics product that goes beyond a TCAS system.

RW: We're expecting to have that available by the end of the year. TCAS integrated into the XP.

JT: One clarification - the Due Regard radar, right now, is being integrated onto the larger aircraft; the Predator B, not the XP. I would like to think in the future, that is a potential thing to do, but there's size, weight and power (SWaP) issues that have to be overcome, because we have a smaller platform with less space on board. So at this point in time, the Predator B aircraft that we're selling to the U.S. Air Force, foreign allies, Homeland Security, that is the aircraft we're integrating the Due Regard radar into, in the nose. TCAS is what we're integrating onto the Predator XP.

DIB: While we're talking about the Predator B, I understand recently there was an announcement - the first flight following the extension of the wings on the Predator B, which successfully brings greater range endurance to the UAV. Will there be any upgrades to the engine, fuel tanks, or datalink, to better accommodate this increase in range?

JT: I personally don't know about the engine or datalinks...fuel system, potentially, by having a wingspan that's about 13 feet longer than the standard Predator B, since we do use wet wings - we have fuel in the wings - there's potential for adding more fuel to the wings.

RW: The programme that we have in development for delivery in...let's say 2018, right now is the certifiable Predator B configuration. And the certifiable Predator B was designed specifically for international customers, specifically to comply with a host of different airworthiness standards across Europe; that's going be extended into other countries as well. The idea behind the extended range and the 13-foot longer wing is that that's essentially the first step in the development of the certifiable configuration.

JT: So it increases the endurance from about 27 hours to over 40. Which is significant, but also helps with short-field take-off and landings. It also has some lightning protection that we're incorporating onto these long-wings, so as Rob said, it's a step towards a certified Predator B.

Tejas 'shines' out of India for the first time

In Sanskrit, 'Tejas' means 'brilliance', 'shine' or 'brightness'. At the start of the year, all these fabled attributes of India's indigenous - and long-delayed - Light Combat Aircraft (LCA) were focused onto Sakhir airbase in Bahrain, where the type made its first international debut. While the the design appeared to be mature, there was also pride and confidence on display among the accompanying high-ranking industry and political representatives.

DIB's Georg Mader went to Bahrain to speak with the 'Tejas' programme-director and head of all Indian Aeronautical-Development (ADA), as well as the new secretary in the Modi-government for defence research (DRDO)...

DIB: For our European readers, can you please tell me which one of you is involved in the LCA? You are said to be quite new in your functions, but I suppose that's not the case with the long-slipping 'Tejas'...

CD BALAJI (smiling): No, that's true. We've both been associated with it for many years. My background is naval-aviation and later I became the programme-responsible within the national aeronautical-development for the LCA's naval version, then later for all combat-aircraft and, since last July, director of the whole agency.

Dr S CHRISTOPHER: My scientific background is in design and development of the slotted array technology, which has been used in several airborne and missile projects. I also work on the LCA's multi-mode radar. More recently, I was head-of-programme for our airborne early-warning- and control-system aircraft [AEW&C] and director of the centre for airborne-systems (CABS) at Bengaluru. Since last July, I've been secretary for research within the Indian DoD and director-general of DRDO.

DIB: A grim picture has been painted by your air-chiefs in the IAF, of India having too few squadrons against the air threat situation – something like 28 where there should be 40. In the next few years, the MiG-21 'Bison' will be retired and then the MiG-27s. Can the 'Tejas' counterbalance this? It was originally intended to replace the MiG-21...

The Tejas is powered by the General Electric F404-IN20. Image: Jeremie M. Yoder

CHRISTOPHER: These are the requirements of the IAF leadership. Politics are trying to support this in helping them out, based on intelligence-based threats as well as by the budget. I know what you mean in pointing to the long history the plane has had, but it was a brave and ambitious undertaking to begin this project, and it's now finally bearing fruit. Of course, I would love if only 'Tejas' replaces all the old types. And not just in India...

DIB: So, did you bring the 'Tejas' here to Bahrain because you're looking to sell overseas? The programme has taken so long to mature and the recently agreed production at HAL will take years... Do you really see capacity and chances for exports at this stage?

CHRISTOPHER: It was very important that we could come here to demonstrate to the world that India is capable of producing a world-class fighter plane. It was quite different from flying in Bangalore at AERO-INDIA. Here, a discerning audience was watching the performance very closely and the feedback has fed my curiosity even more. We are ready to build the 'Tejas' at a rate of 8 per year now and at least 16 per year

from 2017 onwards. Nations are already making enquiries about its capabilities. Our lengthy teamwork has finally paid off, so we're just very proud. Our aim was to ensure we have a quality product – not just for indigenous requirements, but also for exports. We're currently ramping up production, so for any export order we would be ready to dovetail.

BALAJI: You're right, 'Tejas' has taken a long time. But the world now wants to know if it really is a +4G fighter aircraft. Today they saw the proof, right here in a region that is always a profitable market for combat-aircraft. There's good interest from the trade observers and Middle East buyers. Yesterday we had a specific discussion with customers from Abu Dhabi who are requesting information. And we have verbally received interest from many other delegations. We'll host some of them in India in April.

DIB: The two aircraft now here at Bahrain – what are these? Low-rate initial-production versions? How many prototypes were there?

BALAJI: These here we call 'Limited Series Production'(LSP) aircraft. Before them, there were five prototypes called PVs. Actually there was no PV4 because we decided to have two two-seaters, which were the PV5 and PV6.

Outside the LSP, there are seven of them with No. 4 and No. 7 here today at Bahrain. They will be followed by an initial serial production of 20, with the first already delivered to the Indian Air Force, and then another 100 planned [for the IAF].

DIB: These 100 will then be what you call 'Mark.1A' right? With the US-supplied GE404-engine...

CHRISTOPHER: Yes, the 'Mark.1A'. The initial 20 are just the 'Mark.1'. Both have the F404-IN20 engine.

DIB: So what does the 'A' stand for?

BALAJI: It will have some major improvements against the basic '1', including the integration of the EW suite with a self-produced jammer. Subsequently, there will be an AESA radar – at the moment, in the first 20, there is the mechanically scanning slotted-array of the ELTA EL/M-2032. For the AESA, we have options for a US product or a joint Indian-Israeli-product based 60:40 on an upgraded variant of the ELTA EL/M-2052. It will be decided this year upon its maturity. And of course Mk.1A will have in-flight-refuelling.

DIB: Regarding final flight-testing before initiating production – what does the aircraft have to prove for flight clearance?

The aircraft on display at the Aero India exhibition. Image: Defence 19

BALAJI: 'Tejas' has undoubtedly come of age. It has extended its flight envelope in reaching the full +8G/-2G-level and the angle of attack of 24°. We have to clear it a little more before it's released to manual service. Structurally the aircraft is cleared for 12G, so we're confident to release it to actual service.

DIB: What's the status on weapons integration?

BALAJI: At this initial stage, weapons integration is basically completed, both in terms of air-to-air and air-to-ground – the latter with unguided- and precision-guided bombs. What still needs to be done is to fire the gun from the aircraft while airborne. When we return the LSP7, the gunnery verification against air- and ground-targets will commence. The same aircraft will then go on to its necessary BVR missile firings, as so far just the WVR missiles have been integrated.

DIB: What weapon will that be? An Indian one?

CHRISTOPHER: Soon it will be an Indian one – the radar-homing 'ASTRA', which has already been fired from Su-30MKI. On the LCA, we will first integrate the Israeli RAFAEL 'Derby' BVR-missile. For WVR or IR-weapons, the Russian Vympel R-73 [AA-11] is already integrated and the Israeli 'Python 5' will follow suit.

DIB: Tell us about the two-seaters – they'll be part of series production, right?

BALAJI: Of course, it's needed for OC [Operational Conversion], but the twin-seater on this aircraft is not critical as we've established a very good synthetic substitute in form of a capable high-fidelity simulator. That's been done indigenously, under DRDO. The pilots – although all experienced – felt very comfortable transitioning from the simulator to the real ➡

The Briefing Room

The Tejas Light Combat Aircraft. Image: wikimedia

aircraft, even without a trainer. For regular squadron ops, there will be some two-seaters in each batch. However these will be operational aircraft, which also can do many other things...

DIB: Ah – like EW, battle-management...

BALAJI: Exactly. Other specialised roles besides just training.

DIB: On the subject of specialised roles, we have to touch on the naval version of 'Tejas'. As you initially said, Director Balaji, this has been your 'baby'...

BALAJI (smiling): Yes, thank you. Concurrently with the basic version, we are proceeding with the naval variant. This – as you well know – has its own challenges. For the Indian Navy, it is built to operate from a ski-jump carrier under the STOBAR-concept [Short-Take-Off-But-Arrested-Recovery]. Therefore it needed an arrester-hook and different, stronger landing gear. Before it could deploy out on a ship, it had to be tested on land. That was when, under my supervision, we built a ski-jump at Goa. Commodore Jaideep Maolonkar did the first 'jump' from there on NP1 in December of 2014. The result was that the aircraft performed even better than the team ever thought it could.

DIB: In what way?

BALAJI: The cautious flight-test team decided to lock 5.7° as the minimum-climb angle for the NP1 once it made the leap off the ski-jump. When the aircraft did that, the minimum climb angle was observed to be in excess of 10°! Soon NP1 achieved an angle-of-attack after ramp exit of 21.6°, giving the team enough of a new 'healthy' margin to work with in terms of performance. The arrester-hook was also successfully tested and is now integrated into the airframe and flight-controls.

DIB: Even so, we've heard that the Navy has had doubts over the initial version's thrust output, meaning the GE414 engine – the one in the 'Super Hornet' – which was planned for the future Mk.2, would have to be integrated earlier. Is that the case?

BALAJI: Yes, but just for the naval version for now. A land based Mk.2 is another, more distant thing. For the carrier version, that margin of extra power of the F414-IN56 is definitely needed. Besides that, we are in the comfortable position of having both engines fitting into the airframe without many changes required.

DIB: A question about the 'Tejas' all-round combat power...We all know that India feels 'encircled' by China and what you call their 'proxies', Pakistan. The latter have F-16s and their JF-17 'Thunder' while China also have Sukhois and several – even stealth(y) – developments. Do you see – in a larger conflict scenario – the 'Tejas' as competitive, not only as a survivable striker but also as a 'killer' in the skies?

BALAJI: It's certainly competitive. We have done well on weapons integration and we have done the

> We as engineers have to provide the pilots the ability to exploit the maximum capabilities of a new plane

'swing-role' that allows air-to-air and air-to-ground in the same sortie. Also the aircraft is very easy to handle. It's small – even a little smaller than the Swedish 'Gripen', which is an advantage in air combat. Our senior pilots are all very confident in its survivability. They say we have not produced what you would call a 'lame duck' but quite the contrary.

CHRISTOPHER: I have to add here that survivability and competitiveness only come to their full fruition with the addition of human capability and man-machine interface. Only as a symbiosis can they survive and succeed in wartime. We as engineers have to provide the pilots the ability to exploit the maximum capabilities of a new plane, developing this with our own hands and with the pilots in mind. Of course, we also have to take into consideration space and the inevitable possibilities for various improvements demanded by those our pilots or suggested by the technicians in the future.

DIB: How long do you think HAL [Hindustan Aeronatics Ltd.] will need to deliver those 100 '1.As'? HAL has so many other commitments – like the HAWK, the Mirage modernisation, the Jaguar DARIN-III upgrade, even the potential PMF [Indian 5th-Gen fighter based on the Sukhoi T-50], all in the mid-term future. Isn't this again prone to a repeat of endless delays, for which HAL has become infamous?

CHRISTOPHER: Exactly. With a production-rate of 16/year this would take six or seven years. Nobody wants that, in the light of these urgent requirements mentioned by the IAF. And 120 will nowhere be the final number in the end. However, that low rate is only calculated on the capacities of HAL and therefore we are thinking of increasingly outsourcing for parts or whole sections to private sector suppliers. This would be done in the same way as the Airbus C295, which saw those 56 medium-transports assembled by the private Airbus-partnered Indian company 'TATA Advanced Systems' (TASL) to replace the IAF's aging Avro 748Ms. Or in the same way that helicopter parts have been provided through partnership with Sikorsky. So the fuselage can come from here and wings from there, all to speed up the process. Of course, it would all remain under HAL's quality control.

HAL Tejas NP-1 takes-off from the Shore Based Test Facility at INS Hansa, Goa. Image: Indian Navy

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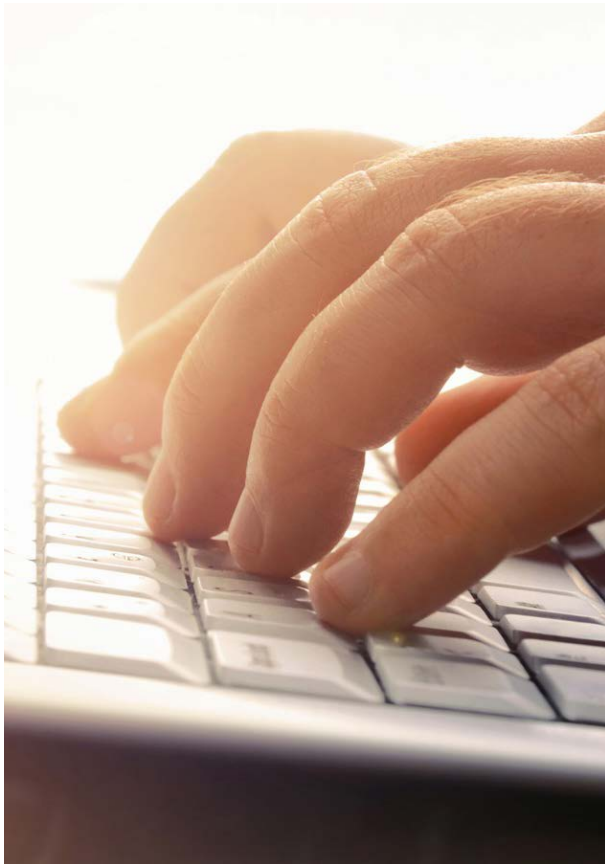

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