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CONTENTS


Page 16

Front cover: The next generation of the Future Airborne Capability Environment is being driven by many factors including greater levels of integration. (Photo: US DoD)

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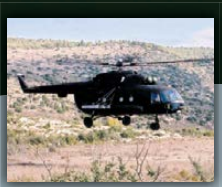

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Helen Haxell, Deputy Editor

Desert deals

Middle Eastern procurement of military helicopters from the US is not a new thing, although imminent deliveries and FMS deals in the region by Boeing appear to have been leading the charge recently.

I visited the company's facilities in Mesa, Arizona, in June and the sand and dust gave me a real taste of their attack helicopters' combat readiness for overseas deployments, with particular regard to the US Army stationed in Afghanistan and Kuwait.

It is hardly surprising that the AH-6i has proved a procurement must for Saudi Arabia and an FMS deal by the Qataris for AH-64E Apaches has been secured. With their deserts and hot-and-dry conditions these countries need robust aircraft to deal with the elements.

With variants of the aircraft operating for the US Army and its deployments in the region, it is easy for Middle East operators to see the transferable capabilities.

The hover performance of the AH-64E is boosted by the composite main rotor blades, providing greater HOGE capability for those desert missions.

On 7 June, the US DoD announced that Boeing had received an FMS contract from the Qatari government for 24 of the type.

The award is worth $667.5 million and includes one Longbow crew trainer. In addition, it will also cover ground support equipment and Thales radios.

US Congress was first notified of the-then prospective FMS to Doha in July 2012, and company officials confirmed that the estimated completion date for the aircraft will be May 2020.

> ***"Assisted by its two-and-a-half-hour mission endurance, the AH-64E has already chalked up 28,769 combat hours for the US Army."***

Mark Ballew, director of global sales and marketing for attack helicopters at Boeing, commented that ten further global defence forces had expressed strong interest in the aircraft.

Assisted by its two-and-a-half-hour mission endurance, the AH-64E has already chalked up 28,769 combat hours for the US Army.

Additionally, the delivery of the first batch of AH-6is to the Saudi Arabian National Guard (SANG) is imminent from the Mesa facility.

With the first set of aircraft progressing through the final stages of the assembly line, as seen by *DH*, the SANG – the launch customer for the AH-6i – is due to receive the first of its 24 aircraft by the end of June.

In 2010, Saudi Arabia announced its interest for the type, with a notification outlining that the country was looking to purchase 36 AH-6is. The aircraft was part of a multi-billion-dollar defence deal which also included AH-64, UH-60M and MD 530F helicopters.

The aircraft will be based at Khashm Al An airfield on the outskirts of the Saudi capital Riyadh. It is anticipated that the AH-6is will start flight testing around the middle of June before being handed over to the SANG.

The company was unable to disclose whether MD Helicopters would continue to build the baseline AH-6i airframe or whether it would bring this in-house some time in the future.

The AH-6 has the capacity for fully integrated weapons management. The light attack helicopter is able to employ M260 seven-shot rocket pods, .50cal GAU-9B or M134 miniguns, and/or semi-active laser-guided Hellfire missiles.

According to Boeing officials, in total there are currently 45 campaigns in 32 countries for potential additional sales, although these negotiations are obviously at different stages.

It will be interesting to see how many of these come to fruition over the next year and what takes flight for whom. ■

In the next issue

- Night vision
- Self-protection
- Utility helicopters
- Cockpit upgrades

Return of the Battle Hawk

Sikorsky is looking to strengthen its hand in Poland with the display of a weaponised version of its S-70i Black Hawk at Exercise *Anakonda 2016*. Featuring a representative sensor and weapons suite, the PZL Mielec-built aircraft was displayed at the exercise in Drawsko Pomorskie, Poland, on 16 June. The company is hoping to highlight the multirole nature of the helicopter, particularly as a shadow lingers over Poland's procurement of Airbus Helicopters' H225M Caracal for the country's utility helicopter tender.

Speaking at Eurosatory in Paris, Joel Villa, regional director for Central and East Europe at Sikorsky Aircraft, said that the company expected an armed version of the Black Hawk to have a ready-made customer base.

'We do believe that there is a market here for an armed utility helicopter. The reason is because of the ghost of the Mi-24. It was an amazing aircraft because it had guns and it could carry troops. Many of the countries in the region operate the platform, but for political reasons, they can no longer operate Russian aircraft. We are looking to offer them the next Mi-24,' he explained.

As well as providing a potential opening in Poland, the offering of an armed S-70i would likely appeal to a number of ex-Warsaw Pact countries, including the Czech Republic which has a current programme centred around an 'Mi-24-type requirement'.

Commenting on the company's presence at *Anakonda 2016*, Janusz Zakręcki, president of Sikorsky subsidiary PZL Mielec, said that the goal was to provide militaries with 'the flexibility to quickly convert their Sikorsky aircraft into a weaponised platform'.

PZL Mielec stated it could deliver baseline S-70i Black Hawks in less than 12 months, while earlier this year, the company shipped its 300th helicopter cabin to Sikorsky for US Army UH-60 production.

DH understands that the aircraft at *Anakonda 2016* features an L-3 Wescam sensor and Hellfire missiles, although these are only representative and the aircraft's architecture allows a variety of armaments to be integrated.

An armed S-70i will also be exhibited at the Farnborough Air Show, where the configuration is more likely to feature Lockheed Martin's new Infirno EO/IR pod, which was on display at Eurosatory in Paris.

The offering of an armed S-70 is somewhat of a change of direction for Sikorsky. The policy of the previous owner, United Technologies, was not to weaponise the Black Hawk. Such work was left for militaries themselves to perform or carried out through integration partners, such as Rafael in Colombia with the Arpia programme.

However, following Lockheed Martin's purchase of Sikorsky in November 2015, the defence giant has added its sensor and offensive weapons technology to the mix. While previous armed S-70 aircraft have often attracted the moniker Battle Hawk, Sikorsky has not yet settled on a new designation for the armed variant.

By Tony Skinner, Paris

UAE to receive helicopter simulators

CAE has received a multi-million-dollar contract from the General HQ of the UAE Armed Forces for the provision of a set of UH-60M and Bell 407 Multi-Role Helicopter (MRH) simulators and training devices. The suite of equipment is being provided to the UAE Joint Aviation Command (JAC) for the NorthStar Aviation 407 MRH and the Sikorsky UH-60M Armed Black Hawk (ABH).

The NorthStar 407 MRH. (Photo: CAE)

Both aircraft's simulators and training devices will include the CAE Medallion-6000 image generator with common database architecture. The full-mission simulator, designed and manufactured by CAE for the UH-60M ABH, will include an extreme FoV display system, a vibration platform and a six-degree-of-freedom motion system. It is scheduled for delivery in 2018.

The 407 MRH devices are expected to be delivered to the UAE JAC next year. The high-fidelity fixed-base Level-7 equivalent flight training device will be provided together with desktop trainers and brief/debrief systems.

Further to an agreement last year, NorthStar Aviation and CAE will be collaborating on the 407 MRH through the collection of flight test data and on the development of the aircraft's training devices.

Gene Colabatistto, group president, defence and security, at CAE commented: 'The UAE as well as other Gulf Cooperation Council countries are making significant investments in simulation-based training. These will be the first simulator and training devices developed for the 407 MRH, so our partnership with NorthStar Aviation along with CAE's extensive experience with helicopter simulation will help ensure we deliver world-class training systems on schedule.'

The awarded contracts, made public on 15 June, are worth C$145 million ($110 million) and also include a deal for the design and development of a Naval Training Centre for the UAE Navy.

By Helen Haxell, London

Aussie Tiger achieves FOC... finally

Photo: Australian Army

The Tiger Armed Reconnaissance Helicopter (ARH) of the Australian Army achieved final operating capability (FOC) on 18 April, a mere seven years behind the original goal of June 2009. Brig Michael Prictor, commander of 16th Aviation Brigade, said that the Tiger was 'ready to go as a full operational capability' with a full regiment of two squadrons.

'In the past decade, we have built an attack helicopter regiment which has taken a multi-generational, cultural, philosophical change, and the army is just coming to grips with the fact that we have now got a world-class attack helicopter regiment,' he added. Nevertheless, there are several undisclosed issues not yet finalised as part of its certification, though Prictor promised these would be rectified by year's end.

Tony Fraser, managing director of Airbus Group Australia Pacific, responded to the FOC announcement by stating: 'It will be an operational aircraft for at least the next ten years until any replacement, and we will continue to make it the best possible weapon system we can.' He noted that the Tiger's cost per flight hour had dropped by 30% from 2014 to 2016, and that availability had risen 20% each year over the same period.

The date of FOC had continually shifted. Even as recently as last July's Exercise *Talisman Sabre*, Lt Col Dean Thompson, commanding officer of the 1st Aviation Regiment, predicted FOC would be achieved before the end of 2015. On that occasion, Thompson said that the FOC declaration would cover whole-regiment certification, but that the Tiger had been ready for operational deployment the past two years.

The Chief of Army earlier advised that 'FOC has not been delayed by a new requirement to conduct amphibious operations. The delay was solely due to the reduced rate of effort of the aircraft'. Last-minute milestones delaying the declaration included sustainment and serviceability rates.

Troubled Tiger

The Airbus Helicopters Tiger was selected for Project Air 87 in 2001. The first of 22 units were delivered in December 2004, with the remaining 18 assembled by Australian Aerospace (since renamed Airbus Group Australia Pacific) in Brisbane through until final handover in 2011.

Sounding the death knell for the Tiger, February's Defence White Paper announced that it will be replaced in the mid-2020s with a new helicopter, unmanned aircraft or a combination of both.

Australia's associated 'Integrated Investment Program' document states: 'The Tiger has had a troubled history – essential upgrades are programmed to maintain the capability's effectiveness.' Thus the Tiger has just a ten-year lifespan.

One key problem is its inability to network with other Australian systems due to the incompatibility of its Eurogrid data link with Link 16. It would be very expensive to replace all Tiger radios, so one solution successfully trialled in Exercise *Jericho Dawn*, in March, was to use an airborne communications gateway to translate messages in different formats to produce a common tactical picture.

Northrop Grumman was responsible for supplying this capability, using a Gulfstream aircraft carrying a product based on the Battlefield Airborne Communications Node of the USAF.

After the exercise, Maj Gen Gus McLachlan, the army's Head of Modernisation and Strategic Planning, commented: 'The demonstration highlights how we can better harness the strengths of our team by digitally connecting air and land platforms.' The government has the option of modernising the Tiger ARH to Mark III standard, although it may be reluctant to do so now that its replacement is confirmed.

In the meantime, other contenders have been positioning their attack platforms as an alternative to the Tiger. At the Singapore Air Show, BAE Systems Australia and Bell Helicopter signed an agreement to train, maintain and sustain AH-1Z Vipers, should the Australian Army pursue such an acquisition.

One capability yet to be obtained is amphibious deployment of the Tiger. The helicopter is scheduled to conduct flight deck handling trials aboard HMAS *Adelaide*, the Royal Australian Navy's new landing helicopter dock ship, in Brisbane this month. First-of-class flight trials will occur early next year.

By Gordon Arthur, Hong Kong

News on the web

14 June 2016
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13 June 2016
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9 June 2016
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9 June 2016
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9 June 2016
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Bell's tough talk on attack programmes

Bell Helicopter's commitments to attack helicopter programmes in the Czech Republic and Poland are strong in light of a new MoU signing, as well as tough talk from senior managers.

The memorandum was signed on 11 May at the newly opened Bell Helicopter Prague delivery centre and painting facility between Bell and the MPI group, a Czech Republic defence and security company, as a sign of collaboration on the UH-1Y Venom's weapon systems requirements.

The aircraft is a candidate for the Czech military's medium helicopter programme, with 12 light to medium utility helicopters required by the Czech Air Force to replace its existing fleet of Mi-8/17s and Mi-24/35s. However, there is still no specific deadline for any decision on the requirements.

Investing in the relationship with MPI is demonstrative of Bell seeking to enhance its position in the Czech defence industry, according to company officials. Matt Hasick, executive VP for commercial business at Bell Helicopter, spoke at the MoU signing of the company's ambition for future customers in the Czech Republic.

The 85% technical commonality between the AH-1Z Viper and the UH-1Y Venom means that there are parts widely available, which in turn means cost-saving opportunities for prospective customers.

This point of commonality and interoperability is being leveraged as part of Bell's pitch for the helicopter programmes in both the Czech Republic and Poland. This combined approach also reduces the demand for training.

Additionally, Bell Helicopter is chasing Poland's Kruk attack helicopter programme, which is looking for 32 platforms.

The anticipated announcement from Warsaw regarding the shortlisted contenders for the procurement process is expected this summer. Indeed, some sources suggest it might be revealed at the Balt Military Expo 2016, which is taking place in June.

Joel E Best, senior manager for Bell's European military programmes, commented in relation to the AH-1Z Viper's competitors that the aircraft has a greater capacity to fly longer distances and go faster, even while it retains advanced weapons.

His presentation was titled 'Bell Helicopter Military Programs – our aircraft ensure Europe is ready for the storm' – provocative language which was no doubt trying to appeal to the array of Eastern European journalists present.

He went onto explain how the 'H-1 team is 85% interoperable and equally lethal against armour or ships' and argued that as it was adaptable to different terrains, the Viper would be 'ideally suited for the European region'.

According to Best, the company has had recent informal discussions with Croatia, France, Germany, Hungary, Italy, Romania, Slovakia and the UK, about the benefits of the H-1 model.

By Helen Haxell, Prague

Ukraine advances Mi-24PU2 upgrade

Ukraine's Mi-24PU2 helicopter upgrade has entered into flight testing phase, according to Ukroboronprom, the holding company that controls a vast majority of the country's arms development.

This long-delayed upgrade, undertaken at the Aviacon Kontop Aviation Repair Plant, is the second stage of the Mi-24P upgrade effort.

Ukroboronprom also revealed that during Q1 of 2016, it overhauled a total of 14 Mi-8 and Mi-24 helicopters at the plant and re-delivered the aircraft – seven for the Ukrainian MoD and a further seven destined for foreign customers.

The upgrade effort has been aimed at developing a night-capable attack helicopter, equipped with night-vision and targeting systems supplied by Sagem of France, and armed with the Ukrainian-made Luch Barye-V ATGM system.

The first upgrade stage undertaken in 2010-2011, dubbed Mi-24PU1 and also managed by Kontop, encompassed all-Ukrainian equipment and new engines – the uprated Motor Sich TV3-117VMA-SBM1V in particular had considerably improved hot and high and OEI performance. It was combined with an upgrade of the helicopter's self-defence suite through the installation of the Adros KT-01AV omni-directional IR jammer.

The Mi-24PU1 upgrade package also included an upgraded ASP-17 reflector sight for the pilot with newly added digital processing capability, a GPS receiver, a laser target marker for improved firing precision at night using NVGs, the Bur-4-1 digital flight data recorder, NVG-friendly lighting in the cockpits and external lighting.

The second upgrade stage, originally planned to enter flight testing in 2013, includes adding Sagem multi-function displays, together with the Sagem OLSP-410L1 multi-payload optronic turret, a

Photo: author

mission computer, the VS-1500 audio/video recording system, the Sigma 95L navigation system (with inertial and GPS components) and the Mercator digital mapping module.

The multi-payload turret was modified with a Ukrainian-made laser beam-riding guidance system necessary for the guidance of the new Luch Barye-V ATGMs. The upgraded helicopter also contains Polish-supplied components, such as the PNL-3 NVG and the THL-5NV protective helmet.

By Alexander Mladenov, Sofia

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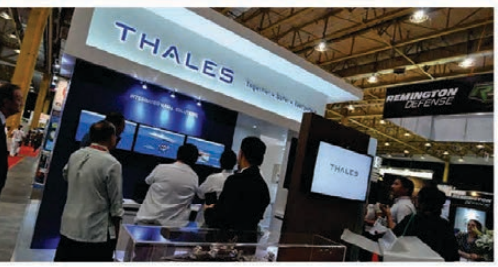

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German heavy contenders weigh in

Photos: via author

As the competition to replace Germany's CH-53G helicopters with a new platform heats up, Boeing and Sikorsky are ramping up their respective efforts, while Airbus Helicopters has suggested it is keeping its options open regarding the German Heavy Transport Helicopter (STH) programme.

The German Air Force currently retains 26 of the twin-engined CH-53G/GSs. At this stage, no requirements detailing its heavy transport needs have been released, although the numbers needed under STH are thought to be about 60 aircraft and the budget has been set at €3 billion ($3.4 billion).

It is expected that an RfP will take place in 2017. Sources are suggesting that a decision will be made one year after this and a contract will be issued in 2019, with deliveries anticipated from 2022-23.

Boeing is putting forward its CH-47F Chinook for the programme. The company has highlighted the CH-47F and the CH-47F ER (Extended Range) variant, the latter of which has been available since 2014, with more than 350 and 80 deliveries respectively.

Michael Hostetter, Boeing's director of vertical lift programmes – Germany, said that the ER variant offers a slightly higher maximum gross weight of 24.5t, a payload of 10t and air-to-air refuelling, compared to the CH-47F, should Germany require it.

He added that the company has a hot production line, building one Chinook every five days, and would be able to increase annual production from the current 50 units to 72, in order to meet any German requirement to deliver the aircraft by 2022. Hostetter said that although Boeing is looking to German industry for support, it was unable to make any announcement on cooperation at this stage.

Purchase recommendation

Hostetter said he would recommend the purchase of one platform rather than a mixed fleet, and less investment in components such as air-to-air refuelling probes, as they can be installed on aircraft as and when required.

The CH-47 has a similar glass cockpit to that being offered by Sikorsky and includes a digital automatic flight control system to allow for more accurate landing in low-visibility conditions.

The ER variant also has a triple hook cargo system for underslung loads and can carry 33 seated passengers or 54 in a high-density emergency situation. The CH-47F can also be transported in a C-17, C-5 or An-124 transport aircraft, with minor work to remove the aft pylon and transmission, although with new connectors this can be done in half a day.

Sikorsky is bringing its CH-53K to the table in an effort to win the STH programme. The CH-53K King Stallion is designed to lift 12t at a mission radius of 200km in hot and high environments – three times the baseline CH-53E lift capability. The aircraft is currently in development and testing with the USMC. Dr Michael Torok, VP of the company's CH-53K programme, said that to enable this lift capability, the K configuration has fourth-generation rotor blades, a split torque gearbox, three T408-GE-400 engines offering 5,393kW and a composite airframe. The aircraft has single, dual and triple hooks to enable it to carry three payloads, as well as a wider cabin to accept standard pallets without modification.

He said that Sikorsky has built growth into its platform, and for the project it has conducted studies into the transportation of not just existing German Army vehicles, but future ones also. The company was not waiting for an RfP but would invest in a team and infrastructure as well.

Torok cited as an example that the CH-53K can carry the Fennek vehicle internally, and could transport two Wiesel tracked vehicles across 85% of Afghan territory in hot and high conditions. If selected, Sikorsky said it would be able to fit any German purchase into its production cycle for the USMC, which wants a total of 200 aircraft.

Guillaume Faury, CEO of Airbus Helicopters, said that the company was in discussions with both Boeing and Sikorsky. He noted that he was waiting for detailed requirements to be outlined in the RfP.

Faury confirmed that once this happens, the company would analyse the situation and continue discussions with both contenders before deciding which to partner with, but would not make any selection before then.

By Tim Fish, Berlin


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While a Boeing AH-64E Apache provides overwatch, soldiers fast-rope from a Sikorsky UH-60M Black Hawk from Taiwan's army. (All photos: author)

Eastern expansion

Growth in the East Asia region has led to most militaries there investing heavily in helicopter platforms, either produced indigenously or acquired overseas. **By Gordon Arthur**

Some of Asia-Pacific's largest militaries – China, Japan, Taiwan, the two Koreas as well as Mongolia – can be found in the East Asia region.

Illustrating the importance of the area's development, Richard Harris, Bell Helicopter's VP of international business development, told *DH* that East Asia was growing to become one of the company's key military product markets.

'There's increased focus on littoral and maritime military requirements that places a high demand on legacy helicopters in the form of speed, range and durability,' he explained, stressing that the region held recapitalisation potential too – Japan, South Korea and Taiwan all possess older Hueys.

The MD 500 is another legacy platform in widespread use. Roger O'Dell, MD Helicopters' director of programme management, told *DH* that the company continued to support these aircraft through both its aftermarket and customer support teams for ongoing maintenance, as well as through OEM upgrade and conversion programmes.

'Looking to the future, as the economic and military significance of the region grows, we're well positioned to expand our installed base and contractor logistics support operations in a number of countries throughout East Asia,' O'Dell said.

Christophe Nurit, Sikorsky's regional executive for Asia, asserted that the East Asia region has always been important to the company. 'In the last six decades, Sikorsky has fostered throughout East Asia some long-lasting relationships that have resulted in first-class industrial cooperation to design, develop, manufacture and support large fleets of aircraft. During that time, the total number of aircraft built by Sikorsky or its regional partners is close to a thousand. There are more than 400 Hawks alone flying in East Asia today,' he said.

Discerning development

China's helicopter fleet is relatively small, given the size of the People's Liberation Army (PLA), which is the world's largest military. The inventory includes the Harbin Aircraft Industry Group (HAIG) Z-9, used for multirole and light attack. One of the most popular types is the Mil Mi-17/171 family,

of which more than 250 are in service. Rosoboronexport completed delivery of 52 Mi-171Es in 2014.

Also notable is the medium-weight Z-8, a copy of Aérospatiale's Super Frélon, although the Changhe Aircraft Industry Group Z-18 will gradually replace it. The Z-18 is a new family based on the civilian AC313, with a glass cockpit and WZ-6C engines. In addition to an army Z-18A transport type, naval Z-18J airborne early warning and Z-18F ASW variants are known.

HAIG's new-generation Z-20, copied from Sikorsky's S-70, took its maiden flight in December 2013. Development continues, and while technical specifications remain shrouded, it does have a five-blade main rotor compared to the Black Hawk's four blades. It could become a future mainstay of the PLA fleet.

Questions remain over whether the AC352, HAIG's version of the Airbus Helicopters H175, will end up in PLA hands. When pressed on this sensitive matter, Airbus Helicopters declined to comment. The AC352 is yet to fly.

China wants to bolster its heavy-lift capacity too, as its weakness was exposed after the 2008 Sichuan earthquake. At last September's China Helicopter Exposition in Tianjin, AVIC displayed a scale model of the proposed Advanced Heavy Lift (AHL) helicopter possessing a maximum take-off weight of 38.2t, 160kt cruise speed, 630km range and 18,700ft service ceiling. Internally it will carry 10t of cargo, or 15t on an external sling. While the AHL will be built in China, it will employ Russian engines. The partners hope demand could stretch to 200 units by 2040.

In terms of attack helicopters, the PLA relies on the Z-10 and Z-19. The Changhe Z-10 benefited from Kamov design input, and first deliveries to army aviation units occurred around 2009. China gave three Z-10s to Pakistan last year. Lighter than the Z-10, the tandem-seat Z-19 is based on the Z-9W armed helicopter. Positioned as a lower-cost alternative to Western and Russian aircraft, HAIG is marketing the Z-19E for export.

Upgrade options

Taiwan became the first AH-64E Guardian export customer when it ordered 30 models in 2007, and received them during 2013-14. Republic of China Army (ROCA) Apaches are fitted with AGM-114L Hellfire and Stinger Block I missiles, and they supplement in-service Bell AH-1W SuperCobras.

The $3.1 billion sale of 60 Sikorsky UH-60M Black Hawks was announced in 2010. The first examples reached Taiwan in December 2014 and the order will be fulfilled in 2018. Both the ROCA and National Airborne Service Corps (NASC), an organisation that performs civil and disaster-relief missions, fly the UH-60M. A quarter of the fleet has been allocated to the NASC, although they can be modified to military configuration if necessary.

The ROC Navy (ROCN) plans to upgrade its fleet of 18 S-70C ASW helicopters, for which Sikorsky seems set to receive a contract. The ROCN also needs to replace old MD 500 ASW platforms, and Sikorsky's MH-60R is in pole position for a ten-unit contract.

Leonardo senses an opportunity, however, and told *DH*: 'It's a capability in which we're certainly very strong with both the AW159 and AW101. Leonardo believes it can offer solutions that demonstrate greater capability and value for money than those being offered by the US.'

The ROC Air Force has three Airbus Helicopters H225s, obtained in 2011, to perform SAR missions. The $111 million contract included a 17-helicopter option that was not exercised. Finally, the state-run Aerospace Industrial Development Corporation (AIDC) is part of Bell's global supply chain. Harris acknowledged: 'AIDC has been a trusted partner and supplier of H-1 tail booms.'

Home-made machines

Japan's aerospace sector boasts Kawasaki Heavy Industries (KHI), Mitsubishi Heavy Industries (MHI) and Fuji Heavy Industries (FHI), which principally licence-build foreign designs. One exception is the Kawasaki OH-1 scout helicopter, of which 38 entered service. The SH-60/UH-60 series is integral to Japan's military.

Nurit informed *DH*: 'Sikorsky provides engineering support as requested from the US... The majority of Japan's UH-60J aircraft are manufactured in Japan, including spare parts required for fleet sustainment.'

The Japan Maritime Self-Defense Force (JMSDF) needs to overhaul its SH-60J inventory, which will be carried out via a life-extension programme. The JMSDF will receive 26 additional SH-60Ks through FY2014-19 funding to replace older SH-60Js.

In 2014, the JMSDF announced plans for an 80-unit requirement of a next-generation SH-X multipurpose helicopter after 2022. Airbus Helicopters decided not to join the tender because it adjudged procurement specifications favoured the SH-60, lending credence to reports that Sikorsky is in the box seat.

Indeed, Nurit commented: 'Near-term requirements of the JMSDF are likely to be met via licenced production with MHI.' The JMSDF itself assumes an improved SH-60K will be chosen. Nevertheless, while it trusts its reliability, the navy is dissatisfied with the SH-60's payload. A Seahawk victory is not a foregone conclusion, however, as other manufacturers are shaping up.

The NHIndustries NH90 is an SH-X contender, as is the Leonardo AW101/ ▶

A mainstay of the PLA rotary-wing inventory is the Harbin Z-9, a copy of the AS365 N Dauphin. Pictured here is a Z-9ZH command helicopter.

The Surion, here in ROKA livery, is a by-product of technical collaboration between KAI and Airbus Helicopters.

MCH-101. Significantly, the Maritime Staff Office (MSO) recommended that the MCH-101 should be chosen. JMSDF personnel are reportedly not sufficiently satisfied with the MCH-101 for it to act as the SH-X, due to spare-part delivery times and its three engines that require more maintenance hours than the SH-60.

Leonardo noted: 'The AW101 has a very long radius of action for offshore SAR, three engines for additional safety, a large and reconfigurable cabin and significant payload to meet the ship-based utility requirements, and with existing helicopters in the fleet, there are benefits in training and support.'

The MSO could eventually override JMSDF objections and, possibly due to intense jostling between SH-X parties, the MoD launched an investigation over collusion allegations. Defence Minister Gen Nakatani announced last December that an Inspector General review would thus postpone the SH-X project.

Leonardo provided 13 MCH-101 kits to KHI for assembly. Ten MCH-101s had been delivered by late 2015, and final handover is scheduled in early 2017. In February 2015, the JMSDF took receipt of the first airborne mine countermeasures variant, which uses Northrop Grumman's AN/AQS-24A minehunting system and AN/AES-1 airborne laser mine-detection system pods.

Collusion case

A major programme for the Japan Ground Self-Defense Force (JGSDF) has already been contracted. The army currently uses Fuji-Bell UH-1H/UH-1J helicopters produced under licence, but it will replace them with 150 UH-Xs over a 20-year period. The MoD had accepted an improved OH-1 from Kawasaki in 2012, but a collusion case between the MoD and the company scuttled that. Subsequently, the ministry changed its policy so that a reworked commercial platform could be adopted as the UH-X.

In a two-horse UH-X rerun, KHI offered a model based on an Airbus Helicopters design, but the MoD announced on 17 July 2015 that it had adopted FHI's proposal for an updated Bell 412EP platform.

Harris provided an update: 'UH-X co-development efforts are under way, with a number of FHI employees now co-located at Bell's global headquarters in Fort Worth, Texas. We're working on a number of design and manufacturing improvements to meet JGSDF requirements targeting enhanced performance, safety and efficiency.'

FHI will begin modifying a Bell 412EPI next year, and Bell will concurrently modify a 412EPI flight test aircraft. 'Our aim is to obtain FAA type certification of the Bell 412EPI with the planned Fuji-Bell variant enhancements in 2018, with certification to be validated later in Japan,' he said.

The MoD should commence operational evaluation of the prototype later in 2018, with first deliveries planned for 2022. 'The Fuji-Bell UH-X programme win validates the proven Bell 412EPI, and extends the availability of the highly capable platform well into the future,' Harris noted.

Buoyed by government policy changes, the MoD expects export availability for the UH-X: 'Export of a commercial Fuji-Bell variant (tentatively called the 412EPI+) is an important component of the UH-X contract that will further improve the MoD's cost targets over the life of the programme.' However, because Bell 412 base technology is not new, exports may prove challenging.

Compensation claim

With Japan flying both the Chinook and Apache, Boeing rates the region highly, too. Jim Armington, Boeing Defense, space and security VP of global sales, Japan, told *DH*: 'We expect at least 30% of our defence, space and security revenue to come from customers outside the US, and East Asia is a big part of those opportunities we see.

'Platforms like the Chinook and V-22 are particularly well suited for humanitarian assistance and disaster relief, SAR and general mobility needs across remote island and ocean territories in the region.'

Japan is the largest Chinook operator outside the US, with more than 70 in service. 'Japan's CH-47 programme has been highly successful for Boeing, KHI and the Japan Self-Defense Forces. Boeing considers the programme, which has continued for more than three decades, one of the best examples of licenced production in Japan,' he commented.

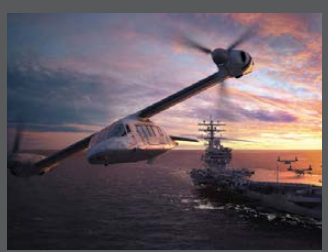
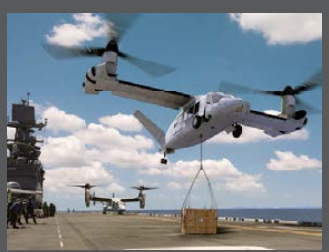
Milestone year

The 100th Chinook will be completed this year. Attack helicopter availability will become a serious issue as the 70-strong Fuji-Bell AH-1S Cobra fleet ages. Japan originally planned to induct 62 Apaches licence-built by FHI, but this was drastically reduced to just 13 examples because of budgetary difficulties.

The JGSDF's final AH-64DJP will be handed over in early 2017. Last year, the MoD was ordered to pay FHI damages of $298 million for downsizing the Apache order to compensate for the production facility it had built. The MoD declared further Apache buys were 'not scheduled at this moment'.

'Going forward, Boeing, in cooperation with the US government, will continue to work closely with the government of Japan to understand their requirements and support any additional needs,' Armington said. Japan will also adopt the Bell-Boeing Osprey, with the US Congress notified in May 2015 that a sale of 17 V-22B Block C aircraft had been cleared.

Some 12 JGSDF V-22 tiltrotor aircraft have been funded to date, and they will be stationed in Kyushu near the home of a nascent amphibious force. The Osprey's range and payload are ideal for defending Japan's remote offshore islands, as ▶

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well as for disaster relief. 'We understand that future purchases are being considered by the Japan Air Self-Defense Force and JMSDF,' Bell's Harris added.

Airbus Helicopters completed delivery of 13 EC135 T2i training helicopters to the JMSDF in 2014. Elsewhere, in March 2015, the JGSDF took receipt of the last of 30 Enstrom TH-480B training platforms.

Production line

In South Korea, the 8t Surion resulted from technical collaboration between Korea Aerospace Industries (KAI) and Airbus Helicopters. The Republic of Korea Army (ROKA) ordered 245 Surions to be produced by 2020. The first ten joined the Army Aviation School in May 2013, and this year production ramps up to three per month.

There is an expectation of 300 Surion export sales, with KAI/Airbus preparing a major marketing push. Surprisingly, the Surion did not appear at its home exhibition, the Seoul Air Show, last October.

A Surion amphibious assault variant destined for the ROK Marine Corps (ROKMC) completed its first flight on 19 January 2015. KAI modified it with anti-corrosion measures, flotation devices, an extra fuel tank, foldable rotor blades, different communications equipment and an external hoist. The ROKMC wants 40 helicopters, with deliveries expected to commence in 2017. Other Surion variants are medevac, SAR and coastguard.

The ROK Navy (ROKN) selected the Leonardo AW159 in January 2013, as part of a 20-platform naval helicopter requirement. The first four Wildcats of the $560 million deal completed site acceptance tests in April, with delivery expected in July and the remainder by year's end.

Korean AW159s are fitted with a sonobuoy dispensing system, Spike NLOS missiles, Link 16, Thales Compact Flash Sonics dipping sonar and K745 Blue Shark torpedoes. The OEM said that the AW159 met 'all the ship-based operational requirements without modification to the helicopter or ship'.

In all, the ROKN needs 40 shipborne ASW and anti-surface warfare helicopters under its Korea Maritime Operations Helicopters requirement. A decision on either domestic development or an off-the-shelf buy should be made this year.

The old and the new. The Leonardo Helicopters/KHI MCH-101 (left) is replacing the Sikorsky MH-53E Sea Dragon in JMSDF service.

KAI is offering a navalised Surion, with partner Airbus keen to help fill a niche in its international portfolio. Leonardo will again offer its AW159.

Sikorsky's Nurit weighed in too: 'South Korea operates one of the largest fleets of H-60 Black Hawk helicopters outside the US, and has expressed interest in MH-60 Seahawk ASW helicopters.'

Concurrent contract

Following their Surion success, Airbus Helicopters and KAI are collaborating on the Light Civil Helicopter and Light Attack Helicopter (LAH) to replace the ROKA's 250 MD 500s and 75 AH-1S attack platforms.

A $1.4 billion contract was signed on 25 June 2015, with Airbus Helicopters edging out the AW169. South Korea's military is seeking 214 LAHs, with the manufacturers eyeing exports of 300-400 over the next 20-30 years.

The preliminary design settled on the Airbus H155, though the 5t LAH will carry a 20mm cannon in a chin-mounted turret, air-to-ground missiles and rockets, with room for six or more soldiers in the rear.

Ahn Hyo Jung of KAI's programme management division said that the LAH, powered by twin Turbomeca Arriel 2L2 engines, will be introduced by 2022. Eventually, the H155 production line will close in France and be transferred to South Korea. Norbert Ducrot, Airbus Helicopters' senior VP for North Asia, noted that it is rare to develop a civil and military platform simultaneously.

South Korea also has a TH-X training helicopter requirement for 41 units to replace MD 500s. Bell announced it is proposing the 505 Jet Ranger X, while Leonardo confirmed to *DH* that it is offering the SW-4. Selection should occur in late 2016.

Speaking in general, O'Dell of MD Helicopters commented: 'We've identified a number of opportunities within the region. Some are near-term and some are further out. There's growth potential for both our single-engine [models] and light twin MD 902 throughout East Asia.'

Meanwhile, under a $1.6 billion deal signed in 2013, South Korea ordered 36 AH-64E Apache Longbows. In late May, the ROKA began operating its first four Apaches after speeding up deployment due to concerns over North Korean bellicosity. Seoul selected a configuration comparable to that of the US Army, and all Apaches are on schedule for delivery by early 2017.

'The army plans to ensure operational capacity for the new platforms by training pilots and repair staff through live-fire drills and other real combat-like training programmes,' officials stated.

Mongolia relies totally on Russian-built helicopters, with 11 Mi-8s (ordered in 1980) and two Mi-171s (from 2008) in its inventory. Their age suggests an urgent need for replacement, but funding remains an issue. While Russia is the obvious supplier, Western manufacturers will doubtless be looking for a foothold.

There is no such chance for North Korea, however, as it remains under a strict UN arms embargo. Pyongyang operates an antiquated fleet that could number anywhere from 250-300 helicopters featuring the Mi-2, Mi-4, Mi-8, Mi-24D, Mi-26 and illegally obtained MD 500E platforms. ■

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RESCUE REHEARSAL

DH provides an overview of the most recent iteration of the multinational *Exercise Argonaut*, held in Cyprus. **By Babak Taghvaee**

The CPAU's AW139 (CP-6) enters the exercise area to perform a winch operation. (All photos: author)

A multinational SAR exercise was conducted, within the framework of the multinational Civil Military Cooperation (CIMIC) Group, in the Republic of Cyprus's SAR region (SRR) at the end of May this year.

Eight countries took part in all three phases of the Argonaut 2016 exercise, involving civil and military vessels – from fast boats to frigates – as well as four fixed-wing aircraft and eight helicopters.

The exercise involved day and night scenarios enabling participants to practise SAR operations after marine and air accidents in the south of the region. The main aim was to raise their level of preparedness for such operations, with particular emphasis on the ongoing humanitarian crisis across the Mediterranean.

Acting as a gateway to Europe and located 100km from Syria, Cyprus has been the destination of almost 4,000 refugees. On 3 November 2015, the country's air force and navy rescued 26 Lebanese and Syrian immigrants from a small boat. It had been spotted seven miles off the south-eastern tip of the island in rough weather.

Despite the strong winds, three police and air force helicopters were used to evacuate eight of the asylum seekers throughout the night. Those suffering from hypothermia and dehydration were transferred to hospitals.

A team of flight crews, rescue personnel and divers are on 24/7 alert with the Cyprus Police Aviation Unit (CPAU) at Larnaca International Airport and the Cypriot National Guard Air Force Command's (AFC's) 460 MED at Pafos Air Base, to respond and act under the Joint Rescue Coordination Centre (JRCC) in the event of a humanitarian disaster. Exercises such as Argonaut are helping crews to increase readiness when faced with unexpected accidents.

Readiness required

The Cypriot SAR units have been operational since 2005, and are joined by other countries, including the UK and its

An Italian Air Force HH-139A returns to the CPAU's helipad after participation in a daylight scenario exercise.

84 Squadron based at RAF Akrotiri, during the exercises.

For years, the AFC and CPAU have been faced with a lack of modern air assets for SAR for a variety of reasons. The CPAU's former fleet consisted of a pair of Bell 412 utility helicopters manufactured in 1990 and 1997.

In 2008, the Cypriot government announced plans to order five AgustaWestland AW139s for the SAR role. Three were delivered to the AFC and used to form 460 MED at Pafos, which was dedicated to SAR operations.

The two remaining AW139s were handed over to the CPAU and based at Larnaca from late 2010.

Exercise Argonaut 2015 was held in three phases on 26-27 May. Participants included a Cypriot Department of Forests aeroplane, two AFC AW139s, the CPAU's AW139s, an RAF Bell 412 Griffin, a USN P-3C Orion and a French Navy Panther flying from a frigate.

The aircraft practised SAR operations including rescuing passengers from a civilian aircraft and a ship in the first two phases, as well as the mass evacuation of civilians from the Middle East towards reception areas in Cyprus. The training focused on SAR, medevac and associated issues.

During the SAR phase of *Argonaut 2015*, a crisis management coordinating team, consisting of representatives of all participating Cypriot state agencies, was assembled at JRCC Larnaca to deal with the incidents.

Second iteration

Exercise Argonaut 2016 was conducted on 30 and 31 May this year.

The first scenario started at 9.00am. During an ongoing evacuation operation from a nearby crisis area, JRCC Larnaca received an emergency call for medevac of 20 injured persons, executed by a Hungarian Air Force An-26, towards the nearest airport, Larnaca International. The scenario continued into the next morning.

The JRCC then received a distress alert from a small passenger vessel with 20 crew and 150 passengers on board, which had participated in evacuation operations in the Middle East. The vessel reported flooding with the definite danger of sinking off the south coast of the island.

Immediately, under the coordination of the JRCC, the National Plan (NEARCHOS) was implemented in order to handle the situation.

Maritime participants of the day's scenarios were two fast patrol boats from the Cypriot Navy, one fast patrol boat from the Cyprus Port & Marine Police, a speedboat from the Larnaca Civil Defence District, the French Navy frigate *Forbin*, a Hellenic Navy missile boat, an Israeli Navy missile boat and four fast patrol boats, the destroyer USS *Stout* and an offshore support vessel, *Flying Enterprise*, belonging to the EDT Offshore.

In addition, ten aircraft were also present (four aeroplanes and six helicopters) from Cyprus, France, Greece, Hungary, Italy, the UK and the US.

In daylight scenarios on 31 May, SAR sorties started with the flight of an RAF Griffin HAR2 helicopter from Akrotiri. As the Griffin's mission neared completion, a CPAU AW139, serial CP-6, departed Larnaca towards the exercise area at 11:00am. The Hungarian An-26 departed at the same time.

After the Griffin left the exercise area, at 11.30am local, CP-6 arrived and hovered over the Flying Enterprise to simulate winch operation.

It demonstrated the rescue of a Hellenic Air Force paratrooper who had jumped from a C-130H along with two other operatives and an inflatable boat. After picking up the paratrooper, CP-6 landed on the *Forbin* while a USN P-3C was flying at 3,000ft during its SAR mission.

While CP-6's mission neared completion, an Italian Air Force HH-139A departed Larnaca to perform its SAR mission. This aircraft is one of two assigned to the 85° Centro CSAR based at Pratica di Mare, and services and parking were provided for the helicopter by the CPAU during the exercise.

After completion of the HH-139A's mission, a Cypriot AFC AW139 entered the exercise area and practised a winch operation, subsequently landing on the USS *Stout*.

The daylight scenario missions finished at 2.00pm local time.

During most of the exercise, the Department of Forests performed observation flights over the Mediterranean utilising an Ayres Thrush T550 agricultural aeroplane in coordination with the SAR helicopters.

Evening exhibition

On the evening of the final exercise day, an exhibition was held in Larnaca Harbour during which the CPAU AW139 CP-6 was demonstrated to foreign observers alongside a static display. The observers had witnessed the day's scenario from on board the *Forbin*.

The JRCC received a distress alert that a civilian passenger aircraft, during its flight from a crisis area in the Middle East, while participating in evacuation operations according to National Plan 'ESTIA', had ditched off the south coast of the island while approaching Larnaca airport due to a malfunction.

Immediately, under the coordination of the JRCC, National Plan 'NEARCHOS' was implemented.

The SAR operations of the night scenario began at 8.00pm and continued until 3.30am, during which one of the AFC's AW139s from 460 MED responded first and performed rescue operations, later conducting a deck landing.

The CPAU also took part with one of its two Bell 412s, serial CP-4. Its pilots were equipped with NVGs and departed from Larnaca at 9.15pm towards the exercise area. The aircraft performed a winch operation and hovered over the USS *Stout*. After CP-4, the Italian HH-139A left Larnaca at 10.30pm.

These helicopters were joined by three more aircraft, with a French AS565 SA, RAF Griffin and HAF C-130H taking part in the night operation. ■

FACING PROBLEMS

The Future Airborne Capability Environment is a major initiative that could finally overcome the issues that have previously hampered open-architecture avionics efforts. **By Peter Donaldson**

High-end military aircraft are mostly software, in terms of development costs at least. The hardware you can see and touch that lifts these platforms into the air and moves them about is cheap compared with the intangible machine logic that controls them and their mission systems.

Current estimates of the proportion of the total development cost that is attributed to software are around 70% and growing. In money terms, that is about $10 billion per aircraft, and about half of this is attributed to rework.

More importantly, the time taken to develop new military avionics, which are exponentially more complex systems of systems, stretches out over decades, driven by demand for ever higher levels of integration and performance.

The next generation of FACE is being driven by many factors including greater levels of integration. (Photo: US DoD)

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The AH-64E Apache's Networked Common Operating Environment was used to test the Data Correlation and Fusion Manager. (Photo: US Army)

Long lead times

Using conventional procurement approaches, governments commission avionics to meet unique sets of requirements for single platform types from single vendors, usually resulting in long lead times (even for urgent requirements), severe limitations on the ability to reuse software and barriers to innovation and competition.

While open architecture (OA) standards are now widespread, aviation has failed to enforce conformance to any that are currently in use, and platform programme managers do not have sufficient funding to take on the cost or schedule risk associated with multi-platform requirements.

Industry, likewise, has had little incentive in business terms to write software that can be used across multiple platforms, a factor that has hampered OA efforts in the past.

The Future Airborne Capability Environment (FACE) is a major initiative launched under the auspices of the Open Group and involves government and industry to solve both of those problems and, in the process, fundamentally change the way avionics are procured and developed.

The technical and business models take inspiration from the world of smartphones, in which anyone can develop an app so long as it meets the interface standards required by the operating environment, whether that is iOS, Android or Windows.

FACE, however, is more open than any of these because, in theory, anyone can build applications, middleware, operating systems or hardware, again so long as they meet the published standards that enable them all to work together.

The FACE consortium is a legally defined, voluntary consensus standards body characterised by: openness; mechanisms to balance the interests of all parties, including industry and government agencies; due process; and an appeals mechanism. As the definition suggests, it operates by consensus.

Healthy competition

Governments stand to benefit from more effective competition among suppliers, leading to reduction in development and through-lifecycle system costs, greater innovation and the modularity and portability of software that promises shorter development times.

The ability to use the same software on multiple platforms, but without cross-platform dependencies, eliminates the need to invest many times for the same capabilities, while a common environment and data architecture allow system-of-systems integration and interoperability.

At the same time, industry should benefit from the creation of new markets for its software, both in new platforms and the opening up of others previously kept closed by the proprietary nature of the software.

Naturally, industry also benefits from the ability to use the same software on many different aircraft types. Other pluses for industry include the reductions in risk to both costs and schedules that common standards enable and the rapid development of new capabilities allowed by standard software interfaces. Systems integrators in particular benefit from the reuse of applications to grow platform capabilities.

New FACEs

Avionics manufacturers are beginning to offer applications that comply with the latest FACE Technical Standard (TS) 2.1.

Northrop Grumman, for example, chose Wind River's COTS VxWorks 653 platform for its Sikorsky UH-60V Black Hawk cockpit modernisation programme, enabling certification to the DO-178C standard, alignment with FACE and ease of portability. Wind River announced the selection in March 2015.

VxWorks 653 is an ARINC 653-compliant real-time operating environment for safety- and mission-critical avionics that provides robust time and space partitioning, ensuring that no two processes or applications try to use the same processor or the same memory space at the same time. It also enables the use of the latest high-powered multi-core processors while supporting the safety base profile of version 2.1 of the FACE TS.

More recently, Rockwell Collins showed off two advanced applications in late January at the US Army FACE Technical Interchange Meeting (TIM) at the Von Braun Center in Huntsville, Alabama. ▶

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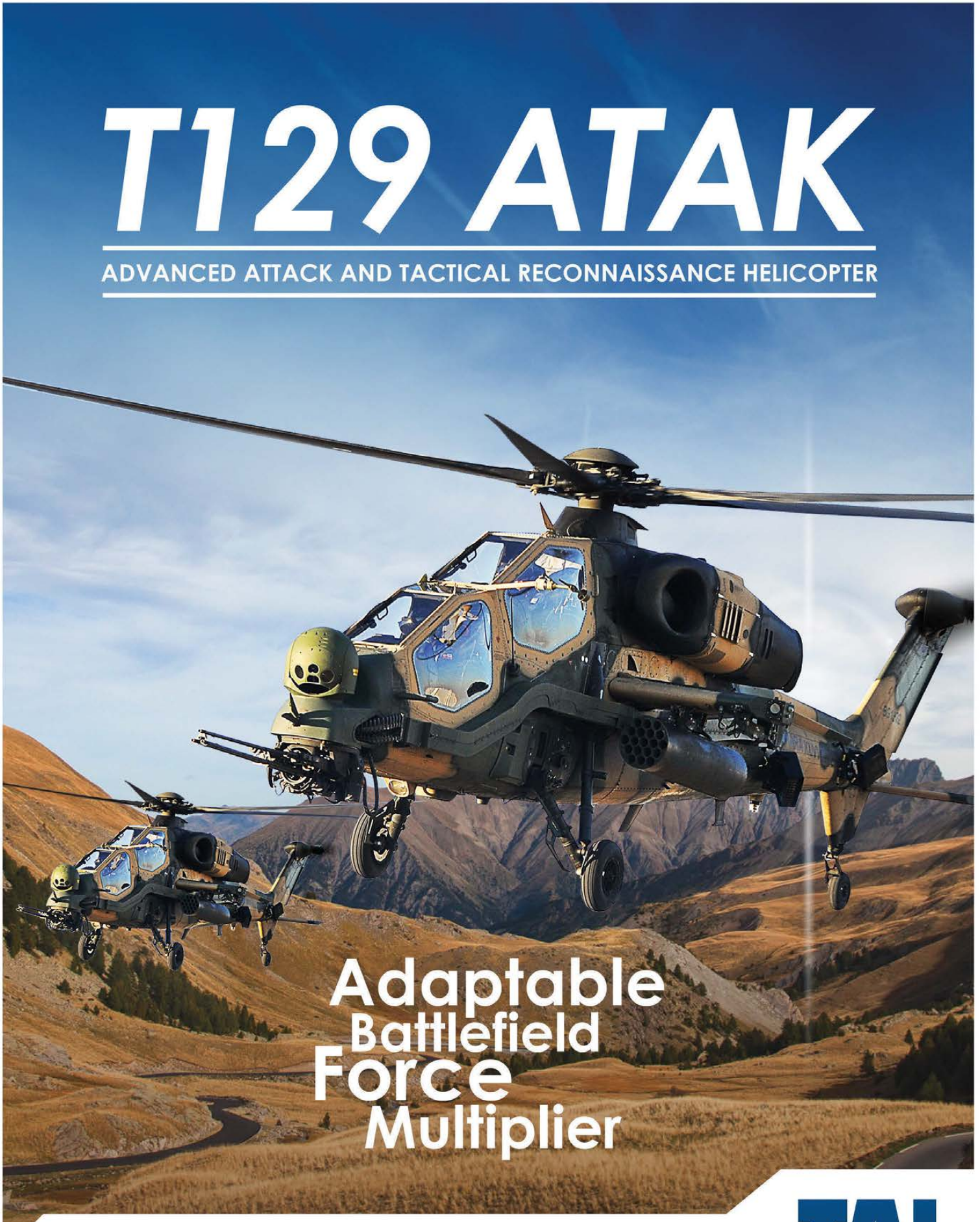

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The first was the Missionized Flight Management Software Application (M-FMSA), which meets the required navigation performance area requirements in providing what the company describes as 'full civil airspace interoperability' along with timely and efficient mission planning.

The second application on show was the Avoidance Re-Router (ARR) that the company developed for use in its Common Avionics Architecture System (CAAS). ARR is designed to provide pilots with alerts to potential hazards along planned routes and suggest ways around them. An embedded real-time application, ARR interfaces with the M-FMSA.

Heather Robertson, senior director of military rotary-wing programmes at Rockwell Collins, said that both products are reusable in many avionics systems, including its own OA flight display system used on US Army Black Hawks and UAV small mission computers.

Lessons learned

Insight into the effort required to ensure that software conforms to the FACE TS and thus work in more than one computing environment came from Sikorsky and Boeing in a paper given at the TIM. It set out lessons learned in the recent Joint Common Architecture (JCA) demonstration in which they developed software for integration into several operating environments aboard military rotorcraft.

This JCA demonstration was focused on the Future Vertical Lift (FVL) family of systems. JCA is intended to provide a conceptual framework that describes a set of avionics subsystems and a 'functionally decomposed' mission computer subsystem comprising a functional model and a semantic data model.

According to Scott Wigginton of the US Army Aviation Advanced Technology Directorate, Thomas DuBois and Andrew Bereson from Boeing and Bill Kinahan from Sikorsky Aircraft: 'JCA will provide a common vision and taxonomy, serve as a starting point for design of avionics architectures and support the development of an avionics software product line for FVL.

'Transitioning from a document-driven procurement process to a model-driven process will reduce the impact of software rework. The FACE Technical Standard and JCA RA enable a model-driven process.'

Sikorsky and Boeing collaborated as a team to develop a DCFM and an RVC. Honeywell also participated in the FACE development set by the army. (Photo: Sikorsky)

Such a model-driven process can potentially provide descriptions that are precise and detailed enough for a machine to generate code automatically, effectively telling a computer what the new software must do and having the computer write it, more of which later.

In their TIM paper, the authors described how they created two pieces of software: a Data Correlation and Fusion Manager (DCFM) that tracks targets based on data from multiple sensors; and a Reusable Verification Component (RVC) to check that the DCFM is truly FACE-compliant.

A lab-based EW suite known as the Modular Integrated Survivability (MIS) system was chosen as the one into which the DCFM was to be integrated, with that work carried out by the MIS team at the Aviation Systems Integration Facility at Redstone Arsenal in Alabama. The MIS contains four operating environments, multiple sensors, multi-function displays and software built to the FACE standard.

In line with its intention to exercise the standard, validate the JCA concept and reduce risk for follow-on efforts, the army picked two separate teams to develop a DCFM and an RVC each. Sikorsky and Boeing formed one and Honeywell the other. This article focuses on the Sikorsky/Boeing effort for brevity. Neither team was shown the composition of the MIS until after it had delivered its software.

Operating environments

A Situational Awareness Data Manager (SADM) was the first of four operating environments within the MIS into which the DCFM would be integrated and tested with the RVC.

The others were the AH-64E Apache's Networked Common Operating Environment (NCORE), the S-97 Raider's Cockpit Remote Processing Unit (RPU) and an advanced security-based OE using the Wind River VxWorks MILS 3.0 operating system hosted on a PowerPC 5020 dual-core processor. All remained undisclosed to the development teams until after delivery.

Subsequently, the team developed a safety-critical application – Formation Flight – as a unit of portability (UoP) to assess the airworthiness implications of applying the FACE standard and identify concerns with performance resulting from the use of the Transport Services Segment (TSS), said the team.

The DCFM was built to take in sensor track information from the SADM and output a list of correlated tracks, combining those identified as single entities. For example, it might compare data from sensors aboard the aircraft such as a radar, a radar warning receiver and an IR camera and decide that they all relate to the same target. Using its simulation capability, the MIS put each DCFM though a common scenario in each operating environment.

Defined as a FACE UoP, the DCFM was provided with an interface in the form of a FACE data model plus two behaviour component interaction diagrams. Data models organise elements of data and, for example, standardise how they relate to each other. Their main purpose is to support information systems development by providing common definitions and formats for data so that different applications can ▶

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share it. Component interaction diagrams show how data flows among components of a system.

The primary development took place in a Linux environment and made use of an ARINC-653 simulator.

The RVC's role was to test the DCFM in all the different operating environments by capturing the input conditions, expected results and traceability data that linked the RVC test cases to the matching DCFM requirements. It also ensured compatibility with host hardware and provided verification of the platform integration as lifecycle changes were made to each operating environment, said the Sikorsky/Boeing team.

The government also sought verification of candidate FACE tools created by Vanderbilt University's Institute for Software Integrated Systems (ISIS). These included a conformance test suite, modelling tools and an interface definition language (IDL) compiler.

Finally, said the team, the Aviation Systems Integration Facility's FACE Verification Authority (VA) evaluated the DCFM's conformance with version 2.0 of the technical standard.

More cohesive

To create the DCFM, the team took an existing Boeing data fusion algorithm called Cohesion, which has been deployed aboard several military platforms, including Boeing's own P-8A Poseidon maritime patrol aircraft, adding a FACE-compliant software interface layer and the DCFM data model.

Cohesion's interface layer was adapted to the FACE transport service API and the data model. The candidate IDL compiler from ISIS used the data model to generate key parts of the DCFM software automatically.

Also developed as a UoP, the RVC worked by emulating the Situational Awareness Data Manager (SADM) interface to put the DCFM through its paces in a series of test cases that the team developed. As with the component it was designed to test, the RVC was also developed using a model-based tool. In the RVC's case the tool used models of the test cases to generate much of its code automatically.

FACE could overcome issues stemming from previous open-architecture avionics efforts. (Photo: Northrop Grumman)

The team provided preliminary and initial evidence packages to the army's VA, evidence that included results from the candidate FACE conformance test suite, check list responses and additional artefacts that needed manual inspections.

'Several iterations of the initial package were required to address VA concerns,' said the team.

Processes, tools and lessons learned were more important than performance, they said, emphasising that lessons about application of the FACE standard and tools, the structure of the DCFM data model, interpretation of requirements and use of the FACE library portal all emerged.

As Cohesion is designed to be portable, it proved straightforward to implement the DCFM based on it, said the team, who reported converting the algorithm into a DCFM UoP in less than two months, with a similar amount of time taken to create the RVC. Cohesion's interface had to be aligned with the DCFM model and its software modified to meet the FACE technical standard.

To align the interface, the team built a wrapper to contain Cohesion and attach it to the FACE TSS, providing a thin layer to translate messages between the TSS and Cohesion formats. The wrapper also served to configure and start the Cohesion software.

Model mechanics

One set of issues that emerged related to the mechanics of data model construction. Constructing complex data models from simpler ones led to duplication of fields containing, for example, latitude and longitude information that required the team to make assumptions about which was the authoritative source.

Other issues stemmed from ambiguity in the DCFM data model. While the fields were generally well defined, said the team, the model did not indicate how to use them, while in some cases intended meanings were not clear.

For example, the army and the Sikorsky/Boeing team had incompatible interpretations of the track source field that had to be resolved.

The team also commented that a behaviour model was needed alongside the data model to tell engineers what to expect in terms of track data delivery rates, number of tracks delivered per frame and allowable staleness of sensor data, for example. In this project, these issues were resolved by making 'reasonable assumptions'.

Next, the team integrated the DCFM and the RVC on the three additional operating environments representing current, emerging and future rotorcraft.

The AH-64E Apache NCORE, which includes the Multi-core Mission Processor (MMP), was designed according to OA standards to reduce lifecycle costs, incorporate and field new capabilities quickly, explore new software technologies and improve the organisation of the attack helicopter's existing capabilities.

Experience from its development, according to Boeing technical fellow Ronald Koontz and AATD engineer Dale Johnson, can benefit FACE development, while NCORE itself evolves to align more closely with the FACE standard.

In NCORE, the DCFM UoP was implemented within an MMP emulator running a Wind River VxWorks 6.9 x Linux General Purpose Profile. In the S-97 Raider's cockpit RPU it was integrated into a VxWorks 653 safety profile running on a PowerPC 7457 processor. In the FVL-related environment, it was integrated into VxWorks MILS 3.0 security profile running on an advanced architecture PowerPC ▶

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5020 dual-core processor. All were verified using the RVC.

The DCFM UoP software ran successfully in all three of the extra environments, the team reported.

Formation Flight

Finally, to try FACE-compliant software in a safety-critical environment and identify any performance concerns arising from the use of the FACE TSS, the team adapted an application called Formation Flight into a UoP.

This program uses positional information from multiple aircraft to direct the autopilots on all of them to fly in formation along a selected route, either as a pilot aid or an autonomous controller. Due to its interactions with the aircraft flight control system, it must operate within the rigid timing constraints established for such software.

The team created a FACE data model for Formation Flight, along with a test harness to perform the verification role, as the RVC did for the DCFM, plus an auto-coding tool to interface with the control laws implemented for the application in the lab. Although it was not taken through the verification process, early results indicated FACE did not introduce any troublesome latencies, said the team.

They concluded that the JCA demonstration achieved its goal of using a model-driven acquisition approach using the FACE standards and tools, showing that they provide the independence from the underlying platform by creating an application and a test component that worked in multiple environments with minimal changes.

This approach, they said, was partially successful in reducing the impact of costly software rework through consistent interface definitions and support for generation of applications and test tools.

While the FACE data model, they commented, allowed key entities to be accurately described, it did not describe the relationships between properties or behaviours associated with the data properly. Furthermore, legacy software originally designed to work in multiple operating environments can be reused successfully if the semantic aspects of its data elements are well defined.

Accurate descriptions of data and the behaviours associated with it could be about to become more important still if Gordon Hunt of TRG Systems and Chris Allport of New Spin Robotics are proved right in their bold claim that the power of existing data model standards make it possible to 'document data so rigorously that even a computer can understand it'.

In their presentation at the same TIM, they held out a vision of a future in which a system integration can be performed by loading a documentation file.

'This will practically eliminate the need for costly, time-intensive integrations,' they argued. 'The process of documentation effectively becomes the integration.' ■

Keeping the **blades turning**

Complex machines such as attack helicopters require innovative maintenance solutions in today's tight budgetary environment.

By Peter Donaldson

With the Apache fleet in the lead, the US Army is achieving solid and useful reductions in aircraft downtime and increases in mission availability through the application of a big-data-driven approach to caring for its helicopters known as Condition-Based Maintenance Plus (CBM+). This builds on decades of effort to turn the care of complicated and safety-critical machinery into a science. It also saves Uncle Sam money in an era of automatic budget cuts and so-called cost-wise readiness – 'the right readiness, at the right cost, at the right time'.

In an ideal world, all machinery would keep operating safely, efficiently and reliably no matter how hard it has to work – indefinitely and without maintenance. In that respect, a helicopter is about as far removed from an ideal machine as it is possible to be. Given that real helicopters demand maintenance, and lots of it, the ideal situation would be to perform only work that is truly necessary, changing components just as they are about to fail, for example. The real world again intrudes with uncertainty about when components will fail and a duty of care to those who fly in helicopters.

This uncertainty drives prudent organisations to build large safety margins into their maintenance policies and practices by setting TBO and maximum allowable operating time (MAOT) limits for critical components. These limits start out conservative with new aircraft types and are gradually extended as operational and overhaul experience builds, but this crude empirical approach to reducing unnecessary maintenance is very slow and can miss problems that can lead to ▶

A US Army technician examines the internal parts of an AH-64 Apache with a small LED flashlight during scheduled phase maintenance. (Photo: US Army)

catastrophic failures happening inside the ordained limits.

Recognition of this issue goes back decades and has driven development of technologies such as health and usage monitoring systems (HUMS) that analyse sensor data to establish what normality looks like in healthy components, it then looks for trends and anomalies that could be harbingers of trouble. HUMS started life over the North Sea oilfields as a safety initiative and is now mandatory on all passenger-carrying helicopters that serve the offshore platforms in that chilly and unforgiving body of water. However, its potential to reduce the maintenance burden by providing solid, certifiable evidence of the condition of critical components such as gearboxes and rotor heads has proven more difficult to realise.

Wider efforts

Meanwhile, wider recognition of related issues in the industry at large spawned the concept of reliability-centred maintenance (RCM), which is a kind of evolution and combination of approaches that sought to improve upon reactive maintenance – waiting for things to break and then mending them. With the simple reactive approach, all maintenance is repair. While popular and easy to implement, it is inefficient and takes little or no account of the consequential costs of breakdowns, and for safety-critical systems in general and helicopters in particular, it is a non-starter.

The more forward-looking approaches are labelled preventive, proactive and predictive maintenance. The first addresses things that might break and seeks to fix them, usually on a scheduled basis, before they do. The disadvantage of this conservative approach is over-maintenance, with associated downtime and the risk of maintenance-induced failures, wisdom that the old expression 'if it ain't broke, don't fix it' encapsulates.

Proactive maintenance addresses design for maintainability, while predictive maintenance takes the kind of data-centric analysis enabled by HUMS, oil analysis and other non-intrusive techniques, and seeks to calculate precisely and accurately when components will need work. This is also known as condition-based maintenance (CBM) and draws on other powerful techniques such as statistical process control.

Combined approach

RCM seeks to combine the best of all of these to determine applicable and effective actions – not just preventive maintenance – for each individual piece of equipment. RCM seeks to preserve functionality by establishing levels of criticality, identifying and prioritising failure modes and then choosing the correct, tailored maintenance approaches.

CBM+ is a recursive combination of RCM and CBM, according to the US DoD. 'CBM+ directs the performance of maintenance on evidence of need rather than on a rigid time or mileage-based schedule. Using a systems engineering approach,

maintenance decisions are guided by the results of RCM analysis, sensor input, usage history and operating context. The goal is cost-efficient and technically effective maintenance, delivering maximum asset readiness and availability.'

In August 2015, Josh Kennedy, Jim Carter and Matt Carter quantified the benefits of CBM+ to the Apache fleet and explained how its implementation supports the army's cost-wise readiness goals. Kennedy is associate director at the US Army Aviation & Missile Command (AMCOM) Logistics Center's (ALC's) Supportability and Sustainment Directorate, Sustainment Optimization & Analysis at Redstone Arsenal. ALC supports programme executive offices (PEOs), project managers and army depots, while partnering with industry to support warfighters in training and combat. Jim Carter is with the Aviation & Missile Research, Development & Engineering Center's (AMRDEC's) Reliability, Availability and Maintainability Division, and Matt Carter is a member of the ALC contractor support staff and employee-owner at Modern Technology Solutions.

Ideal candidate

The Apache fleet was particularly well suited to the guinea pig role for CBM+ as the aircraft has more digital source collectors and more mature condition indicators (CIs) than army aviation's other helicopters, according to Kennedy et al. Furthermore, the aircraft's maintenance interval requirements were 'extraordinarily conservative', they said, because they pre-date the implementation of CBM on the aircraft. This forced adherence to MAOT and TBO without regard to real need, they emphasised, adding millions of dollars to operating and support costs.

Sometimes, premature failures in relatively minor – although still important – components affect the TBOs of much larger systems. A prime example of this involved the main transmission accessory sprag clutches, which are one-way free-wheel clutches that provide mechanical drive to critical accessories. Unanticipated wear in the primary and secondary sprag clutches led to an airworthiness directive issued in the late 1990s that reduced MAOT to 1,000 hours, with a consequent reduction in the main transmission's TBO to 1,000 hours from its original figure of more than twice that. This is because changing the clutches involves removing the main transmission, which can only be done at depot level. Needless to say, this had a major impact across the fleet.

Application of CBM+ led to a TBO extension to 1,250 hours in July 2011 and another to 1,500 hours in April 2013, resulting in what Kennedy et al described as substantial benefits. Comparable TBO and life extensions have also been granted to other components, with similar benefits, they said.

Authorising these extensions involved 'well-structured collaboration' between several organisations from outside and inside the army. These included the ▶

OEMs for the helicopter, its modernised signal processing unit and other components, plus AMRDEC's engineering directorates, the Apache Program Management Office, PEO Aviation, Redstone Test Center and AMCOM's G3 CBM Office. The University of South Carolina's CBM Test Center and the state's Army National Guard provided further support.

In search of confidence

A key concept in CBM+, a CI is defined as 'a measure of detectable phenomena derived from sensors, that shows a change in physical properties related to a specific failure mode or fault'. Developing and verifying CIs is a long and exhaustive process. One of the biggest challenges lay in the algorithms required to generate the CIs, from vibration data, for example, with confidence levels of 90% or greater, as laid down in the ADS-79 handbook, which sets out aeronautical design standards for US Army aircraft CBM. Any CIs with confidence levels of less than 90% are either treated as highly questionable or disregarded altogether.

Development is an iterative process involving multiple teardown inspections and analyses to verify the algorithms, particularly to eliminate false positives and false negatives, so maintainers (and aircrews) can rely on them. Also, it must be supported by extensive flight testing to ensure that regimes of interest, particularly high-stress manoeuvres, for example, can be reliably recognised so that their effects on components can be assessed.

AMRDEC's Aviation Engineering Directorate, Redstone Test Center and the component OEMs coordinated the teardown inspections, while Redstone and the University of South Carolina each conducted lab tests and cooperated with AMRDEC on the analysis of teardown inspection results. Corpus Christi Army Depot is continuing with teardown analyses through the 'reliability improvement through failure identification and reporting' process, Kennedy et al said.

The Apache Project Management Office and the AMCOM Logistics Center cooperate on post-implementation analysis (PIA) to provide a repeatable means of measuring the benefits of CBM+ in terms of improved efficiency, operational readiness and cost reductions. For example, the benefits of the extensions to the main transmission TBO and the MAOT of its internal sprag clutches have been identified and calculated, although the figures provided in the paper are fictional for a variety of reasons, presumably including security.

Measurable results

Key metrics include the total costs assessed since the project's implementation, the average cost over that time, the reduction in demand for those parts per 10,000 flying hours and the return on investment, all updated quarterly.

Many calculations are performed to measure the project's benefits, including quantities of parts demanded and hours flown in the same time frame before and after implementation and the item's price at unit level for each year in the calculation. The baseline time period used for comparison is usually the two years immediately before implementation, while the time afterwards has to be long enough for the data to be statistically significant.

The rate of demand, which is the number of replacement units required per 10,000 flight hours over the relevant period, is also calculated, as is the demand that could be expected after implementation. The latter is worked out by multiplying the baseline rate of demand by the actual hours flown each year. Multiplying the number of units demanded each year by the unit price and dividing the result by the flying hours for those years yields the average cost per flight hour, while taking into account the expected level of demand for a part after implementation of CBM+ yields an adjusted average cost per flight hour. Cost assessment measures the money saved over a given period after implementation.

The extra flight hours over which a component remains installed are expressed as additional time on wing, a wrinkle on this being the reduced demand for parts that results from the extra time on wing, using the baseline rate of demand for the component concerned.

Fictional example

The paper's authors provide several sample calculations, again using fictional figures, among them a figure for 'additional demands' across the fleet based on the additional time on wing figure. (Additional demands is a potentially confusing expression because it actually refers to a reduction.) Given an additional time on wing of 20,000 flight hours for FY2013 and a rate of demand for the component of 11.63 per 10,000 flight hours, and equivalent figures for FY2014 of 35,000 and 10.84, the saving works out as 58.3 units during those years, as a direct result of the extra 55,000 hours on wing since the TBO extension.

A member of the Mississippi Army National Guard inspects the rear rotor of an AH-64 Apache during daily maintenance at the Combat Readiness Training Center in Gulfport, Mississippi. (Photo: Mississippi National Guard)

Monetary savings directly attributed to a specific change, such as a TBO extension, measured against the baseline time period, define the cost benefit, while the percentage of the overall saving that can be directly attributed to the change is known as the 'direct cost benefit per cost assessment'.

Dividing the monetary benefit by the investment that it took to achieve it yields the return on investment (ROI), which is expressed as a ratio. Further gymnastics yield more numbers by which CBM+ implementations can be judged, including the 'overall cost assessment' ROI and the 'direct' ROI, both also expressed as ratios.

Kennedy and his colleagues conclude that application of CBM+ to the Apache fleet has produced substantial benefits, but caution that the results need years and hundreds of thousands of flight hours to come to fruition. As a measure of its value, however, the work is being extended to the Chinook and Black Hawk fleets. Money saving aside, the deep understanding of these machines that successful CBM+ efforts enable is likely to yield important safety and operational benefits as well. ■

A version of this feature first appeared in the April 2016 issue of *Military Logistics Forum*

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SECURITY MEASURES

The Malaysian Army Air Corps AW109 in its current digital pattern camouflage which was introduced in 2015. (All photos: author)

While a number of defence procurement plans have been put on hold due to fiscal constraints, acquisition of rotorcraft and provision of a new base are indicative of the priority the Malaysian government places on security in east Malaysia.

By Dzirhan Mahadzir

Like most of the world's armed services, each branch of the Malaysian Armed Forces has its own helicopter arm. However, in recent years, priority for acquisition has been given to the Army Air Corps. This is a result of the ongoing security situation in east Malaysia, which has been subjected to a number of kidnappings by various armed groups, who have been operating from the Philippines since the 2013 incursion by the self-styled Royal Sulu Army.

Current plans call for the establishment of a helicopter base in Lahad Datu for the army and Royal Malaysian Air Force (RMAF) rotorcraft to operate out of as part of security operations in the Eastern Sabah Security Zone (ESSZONE). The new MD 530G light attack helicopters and ex-Royal Brunei Air Force (RBAF) S-70A Black Hawks will also operate from Lahad Datu.

Along with their service missions, the three helicopter arms of the Malaysian Armed Forces are often utilised for civil support work such as medical flights and flood relief operations. Formed in 1994, the Malaysian Army Air Corps started with ten SA 316 Alouette IIIs, which had been transferred from the RMAF as training platforms, before the acquisition of 11 Leonardo Helicopters (then AgustaWestland) AW109s in 2005-06.

The army's development plan, 'Army 2010 Plus 10', was issued in 2008 and called for the Army Air Corps to form an aviation regiment consisting of a light helicopter squadron (881 Sqn), a tactical transport squadron (882 Sqn) and an attack helicopter squadron (883 Sqn) along with the command and support structure for the regimental formation.

Originally, the army was going to purchase the Airbus Helicopters (then Eurocopter) AS555 SN Fennec, in a collaborative purchase with the Royal Malaysian Navy (RMN) as part of a move directed by the Malaysian Armed Forces HQ.

Standardised service

The directive was initiated so that the three services could standardise their equipment as much as possible, although differing requirements led to the army eventually opting for the AW109. These 11 aircraft formed 881 Sqn, with ten of the AW109s still in service today. The 11th was badly damaged in January 2014, during a night flying training exercise piloted by a French Army instructor with three Army Air Corps personnel.

No fatalities occurred, although the pilot and passengers did sustain minor injuries. Damage to the AW109 was severe, with the tail and rotor blades broken. The Malaysian Army has yet to issue any official statement in relation to the fate of the helicopter. Since mid-2000, France has had two to three instructors attached to the Army Air Corps providing advanced training.

In 2015, the Army Air Corps began receiving Sikorsky S-61A Nuris transferred from the RMAF. A further ten are still to be received, and they will eventually form the second Army Air Corps squadron – 882 Sqn. Additionally, the platforms will take over the tactical transport role carried out by the RMAF for the army. The Army Air Corps have received four helicopters so far with the transfers dictated by maintenance schedules. As the designated RMAF S-61A Nuris reach their flight hour milestone for scheduled maintenance, the helicopters are sent for an overhaul and then transferred to the Army Air Corps upon completion.

Earlier plans had called for 882 Sqn to obtain a new-build tactical transport helicopter but budgetary constraints led to the Nuri transfer. In some ways, this has not been an ideal solution for the army, given that its intent was to obtain a more manoeuvrable and modern helicopter. The S-61A has been in service with the RMAF since 1968, although a number of the current airframes still have significant life in them.

The army has, in line with the new capability, designated one of its infantry battalions for the air-mobility role. Initial training has begun with large-scale air-mobility exercises to be conducted once the army has its full complement of ten S-61A Nuris.

Platform provision

On 19 April this year, Malaysia signed a MYR321 million ($84 million) contract with Halaman Optima, the Malaysian agent for MD Helicopters, for six MD 530Gs including equipment, support and pilot training.

The contract includes weapon systems such as Dillon Aero M134 miniguns, pods for guided and unguided rockets, the FN Herstal RMP gun pod, Harris radios and L-3 Wescam EO/IR sensors. The Thales Scorpion helmet-mounted cueing system has also been selected. The training for the MD 530Gs will be carried out by MD Helicopters and its pilot training provider, Brunner Aerospace. The latter are currently in discussions with the Malaysian Army on the scope of the training programme.

The six MD 530Gs will be deployed to the ESSZONE area, although the Malaysian Army has not disclosed whether the rotorcraft will form 883 Sqn or if they will be assigned to another unit. Alternatively, they could be incorporated into 881 Sqn.

Initial training will be conducted at the MD Helicopters facilities in Mesa, Arizona, to produce a cadre of personnel who would be instructor-qualified, allowing the Army Air Corps to subsequently conduct its training in-house. Training will consist of basic aircraft qualification and weapon system familiarisation to safely release ordnance. Brunner Aerospace will be working with MD Helicopters and the Malaysian Army to define tactics, techniques and procedures for future requirements and training.

Weapon operations and tactical training will be crucial for the Malaysian Army Air Corps, given the fact that it has not operated helicopters with pilot-operated weapons systems, nor has it conducted any attack helicopter operations.

Two MD 530Gs will be delivered to Malaysia in December this year, with the remaining four expected in Q1 of 2017. Also slated for operations in the ESSZONE area, and to be transferred this year, are four ex-RBAF S-70A Black Hawks.

With Brunei now operating the S-70i variant, the A-model helicopters were deemed surplus and scheduled to be phased out. Malaysia requested the helicopters and is understood to be paying $15 million for the transfers.

Other than stating that the Black Hawks will be deployed to the ESSZONE area, no official statement has been released as to whether the aircraft will form a new squadron or be folded into an existing unit of the Army Air Corps.

A dedicated attack helicopter is reportedly still on the cards. The MD 530Gs are said to be purely a procurement for the ESSZONE security requirement, and will therefore not curtail the army's plan for a full attack helicopter capability.

The Boeing AH-64 Apache, Airbus Helicopters Tiger and Bell AH-1Z have all been offered to the army in the past. These companies are not currently pushing further marketing efforts and are instead waiting for an official word or indication that the dedicated attack helicopter requirement has not been superseded by the purchase of the MD 530G.

Naval rotorcraft

The RMN Naval Air Wing began initial operations with six Westland Wasp helicopters in 1988, which was then followed by an additional six of the type before they were phased out of service in 2001.

During 2001-03, the RMN operated a small number of SA 316 Alouette IIIs, transferred from the RMAF, to keep the Naval Air Wing operational until new ▶

RMAF S-61A Nuris of 3 Sqn on the tarmac of RMAF Butterworth.

Army special forces await extraction by an RMAF Nuri during an exercise.

helicopters were purchased, in the form of the Super Lynx 300 and Airbus Helicopters AS555 SN Fennecs.

The Naval Air Wing currently operates two helicopter squadrons. 501 Sqn has six Super Lynx 300s which were delivered in 2003, and 502 Sqn has six Fennecs, which were delivered in 2004. Both squadrons are based at the RMN's Fleet HQ in Lumut, Peninsular Malaysia.

The RMN does not permanently assign its rotorcraft to a ship, instead it allocates shipboard helicopters on a mission/tasking requirement basis. 502 Sqn's primary role is to provide basic training for RMN pilots, but the Fennecs have been deployed on operational missions as well.

The Naval Air Wing was heavily involved in the anti-piracy escort mission, Operation *Fajar*, in the Gulf of Aden, which ran from 2008 to mid-2014 with Super Lynxes and Fennecs deployed initially on RMN ships. The auxiliary craft *Bunga Mas Lima* and *Bunga Mas Enam* are both modified container ships whose conversions were made in order to reduce the burden and cost of deploying the RMN's surface combatants for the mission.

The initial Operation *Fajar* deployment was a response to the hijacking of two Malaysian-owned tankers in the Gulf of Aden. An RMN task force comprising the frigate KD *Lekiu* and the LST KD *Sri Inderapura* was dispatched immediately, along with a number of commandos drawn from the special forces of all three services and various support personnel for a rescue mission.

On board the KD *Lekiu* was a Super Lynx, while the KD *Sri Inderapura* carried three aircraft – an RMN Super Lynx and Fennec and an RMAF S-61 Nuri. Interestingly, the Nuri was painted white for the mission instead of carrying its standard olive green. Official accounts state that the white paint scheme was for 'camouflage purposes', although no further details have been released regarding the colour change.

Ultimately, no rescue mission was carried out, as a ransom was paid for the release of the ships and crew. The RMN was then directed by the government to dispatch craft to escort Malaysian shipping transiting through the Gulf of Aden in order to prevent further acts of hijacking. Among the Malaysian vessels scheduled to transit those waters during that period was a freighter carrying a delivery of PT-91M main battle tanks to the country's army.

Until July 2009, the escort mission was carried out by RMN ships with the naval auxiliary *Bunga Mas Lima* taking over. In 2011, it was joined by its sister ship *Bunga Mas Enam*, with the two rotating their deployments to the region. All such deployments included the onboard presence of a Super Lynx or Fennec, and in several instances the helicopter played a role in countering piracy attacks.

A Fennec operating from the RMN support ship KD *Sri Indera Sakti* drove off Somali pirates from the Chinese ship *Zhenhua 4* in December 2008, with a burst from its door-mounted machine gun in one incident.

In 2011, a Fennec operating from the *Bunga Mas Lima* with an onboard sniper ▶

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A Royal Malaysian Navy Fennec.

team and door-mounted machine gun, prevented pirates from a nearby mothership from interfering with Malaysian commandos carrying out the rescue of the tanker MT *Bunga Laurel*.

Future missions

Operation *Fajar* was concluded in mid-2014, after it was deemed no longer necessary due to the decreased levels of piracy in the Gulf of Aden. Since then, aside from carrying out normal naval taskings, the RMN helicopters have been deployed off the coast of Eastern Sabah aboard the *Bunga Mas Lima*, which is acting as a mobile sea base in the area. The rotorcraft are also based on a converted oil rig platform as part of operations to prevent seaborne attacks by armed groups from the Philippines.

The RMN has plans to purchase six ASW helicopters, primarily to operate off the under-construction Littoral Combat Ships, the first of which is to enter service in 2019. However, funding has yet to be made available for the procurement, although a number of candidates have emerged. The US has offered the Sikorsky/Lockheed Martin MH-60R while Airbus Helicopters has been promoting a naval H225M, with the advantage that logistics and training would be simplified, with the RMAF already operating the type at that time.

At the Defence Services Asia 2016 exhibition, Leonardo signed a teaming arrangement with Global Komited – a subsidiary of Malaysian company Weststar Defence Industries – for 'the promotion, marketing and distribution' of AW159 helicopters to Malaysia. Due to the country's budget constraints, it seems highly unlikely that the ASW helicopter requirement will emerge as a formal programme any time soon.

The RMAF currently has four helicopter squadrons with a fleet of 12 H225Ms (however, the RMAF continues to use EC725 as the official designation), 16 S-61A Nuris (not including the ten transferred/to be transferred to the Army Air Corps), two VIP configuration S-61s and two S-70 VIP-configuration Black Hawks.

There are four operational squadrons – 3 Sqn and 7 Sqn, based at RMAF Butterworth and RMAF Kuching respectively, operate the S-61As, while 5 Sqn and 10 Sqn, stationed at RMAF Labuan and RMAF Kuantan, operate the H225M.

However, 5 Sqn only has four H225Ms assigned to it with the remaining eight at 10 Sqn. This was the operational entry squadron for the H225M to which all 12 were assigned following delivery in 2013, before four of them were transferred to 5 Sqn in 2014, upon completion of the H225M's full operational capability in the RMAF.

Originally, RMAF plans called for the purchase of four H225Ms in a dedicated CSAR configuration with the remaining eight in a transport configuration. Budgetary constraints resulted in all 12 helicopters being in transport configuration.

The H225M was also supposed to completely replace the S-61A Nuri with additional follow-on procurement, but again the lack of finances resulted in the RMAF continuing with the service of the older type. Malaysia's AIROD was issued a letter of instruction at Defence Services Asia 2016 for a proof of concept for the avionics upgrade of the RMAF and Army Air Corps Nuris.

AIROD signed a contract with Norway-based Heli-One for a glass cockpit upgrade on 21 April this year. No further details have been released about this proposed modification.

At the 2014 exhibition, AIROD was awarded a letter of intent for the upgrade and displayed its proposal, which included a 127x264mm Sagem integrated cockpit display, a 152mm Sagem caution advisory system display, dual Garmin GNS-530W GPS/nav/com systems, dual Rockwell Collins alt/hdg reference systems, Garmin weather radar/satellite weather radar, a Rockwell Collins Mode S transponder and a new DC fuel quantity system. AIROD also proposed option NGV-compliant displays.

Reluctant growth

However, during the period 2014-2016, industry sources said that the RMAF was not willing to approve the upgrade, although it was unclear whether the objections laid with the technical specifications or the estimated cost of the programme. With AIROD's signing of a contract with Heli-One, it appears likely that a new configuration for the upgrade is being proposed.

RMAF Chief Gen Roslan Saad told *DH* in December last year that he would like to see the two VIP S-70 Black Hawks (often referred to in Malaysia as White Hawks, due to their white paint schemes with VIP markings) phased out, and replaced by new helicopters for the role, although funding has not been available for such.

There has been talk of the two helicopters being transferred to the army to augment the four ex-RBAF S-70A Black Hawks, although extensive work would have to be done on the two VIP aircraft to reconfigure them for operational duties, and thus would appear to be highly unlikely.

The RMAF has adopted a privatised option for its helicopter training, having recently signed a six-year contract worth MYR134 million with Malaysian company Gading Kasturi for the leasing, total engineering and logistics support of five Airbus EC120Bs and one H120 simulator for basic pilot training.

Training would be conducted by the pilots of No 1 Flight Training Center located at RMAF Alor Setar, and the helicopters would carry RMAF markings, but ownership and maintenance of the helicopters would reside with the company. The privatisation option was undertaken to reduce the financial, maintenance and logistical burden on the service. ■

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Staying out all night

New technology from Elbit Systems could change the face of night flying.

By Tony Skinner

For commuters leaving Haifa, Israel, each evening throughout April, a helicopter flying a set route on the outskirts of the city became a familiar sound. While drivers on the highway could see nothing in the dark skies above them, the occupants of the aircraft could see the cars below as clear as in daylight, through the use of new night vision technology.

Elbit Systems believes that it has made a significant breakthrough with its BrightNite system, and the company was confident enough in the maturity of the product to take more than 40 pilots on demonstration flight tests to showcase the system.

The mix of Israeli and international military pilots were shown the abilities of the 'staring' multi-spectral panoramic system, which enables helicopters to fly on more than 90% of night missions, according to the company. As well as allowing flight on moonless, dark nights, when there is not enough ambient light for NVGs, BrightNite has been designed to aid pilots during operations in degraded visual environments (DVE).

Gil Russo, the company's senior director of marketing and business development for helicopters, told *DH* that the multi-spectral end-to-end solution delivers essential flight data directly to both eyes of the pilot, enabling head-up, eyes-out orientation in pitch dark and other DVE conditions. 'This is a change of philosophy in what is possible in night flying. Throughout the flight test demonstrations, the feedback has been amazing,' he said.

Economic appeal

Russo explained that in bringing BrightNite to market, Elbit expected the system to appeal to utility helicopter operators whose only current alternatives were the more costly systems typically used in attack helicopters.

Under development for the past five years, the BrightNite system has a radome containing eight uncooled XGA LWIR cameras, and three CMOS sensors housed in a turret carried beneath the helicopter's nose. This staring array is coupled to a high-resolution video output, which projects an ultra-wide field of regard image onto NVGs or helmet-mounted displays (HMDs).

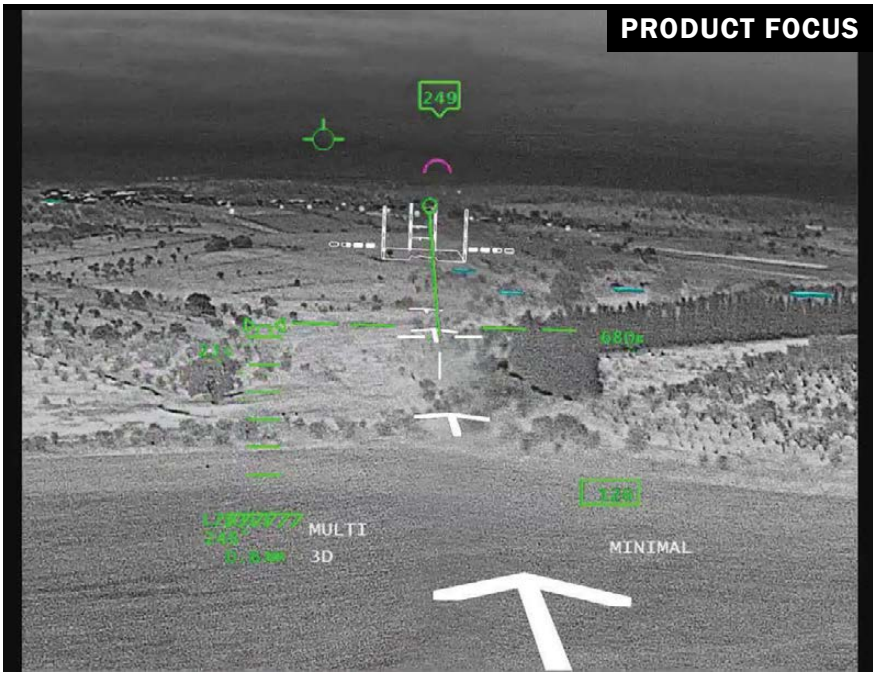
In addition, the resultant real-time panoramic video can be overlaid by synthetic layers that display landscape contours and 3D symbology of known hazards, mission conformal symbology and tactical data.

DH took part in the flight demonstrations outside Haifa, where an AS355 was flown on a set route, showcasing the ability of the

An AS355 demonstrating the capabilities of the BrightNite system. (All photos: Elbit Systems)

Technical specifications

Cameras	
Visible:	low-light CMOS, two megapixel
LWIR:	XGA uncooled 8-12µm, high sensitivity
Pixel size:	17µm
Resolution:	1024x768
NETD:	<50mK
Spectral response:	8-12µm
HFOV:	58°
VFOV:	45°
Frame rate:	60Hz
Field of regard:	200x90°
Weight:	25kg
Power:	~120W
Size:	450x350x300mm
Video out:	Optical ARINC 818
Digital video and data recorder	
Spatial latency:	<2ms
Event latency:	<50ms
Operating temperature range:	-30 to +70°C
Mil-Std:	810F
Frame rate:	50Hz
LWIR window	
ZnS	
Visible near-IR window	
Shafir	



The BrightNite's hi-res images can show 3D-conformal mission symbology, low-visibility landing symbology and synthetic vision.

BrightNite system to provide a clear and bright image of the surrounding area.

Departing from Megiddo airfield, the flight demonstrated first-hand the system's capabilities such as the high resolution image, 3D-conformal mission symbology, low-visibility landing symbology and synthetic vision.

The quality of the image was more in line with systems commonly equipped on attack helicopters, but the company expects to bring it to market at around a quarter of the price of those high-end systems.

The supporting 3D symbology provided advance warning of threats well before they were visible to the naked eye, while also giving pilots the ability to place 3D 'towers' on the ground to act as a visual reference during landing, which becomes crucial during DVE operations. As BrightNite does not rely on a gimballed sensor, multiple crew members can simultaneously scan the entire field of regard, using the same system.

In addition, each pilot can see what the other is looking at, providing a collaborative reassurance of situation awareness. For instance, one pilot can direct the other to a point they see, giving the other pilot the capacity to place their sensor centre-of-view on that point.

For the purposes of the demonstration, the system was integrated with NVGs, which Russo said was an intentional strategy. 'There are two main reasons. One is to educate the market on the art of the possible and pilots are already familiar with NVGs. The other is that it gives you a field of regard of 200x90° and if you look beyond that, it changes to the NVG image,' he explained. 'Certainly with the HMD visor we can give you a wider FoV, but what we have now [with the NVGs] is more than sufficient and you certainly do not feel limited by the FoV.'

Visible advantage

BrightNite has become the company's primary focus in terms of providing a solution that can aid helicopter landings in DVE, taking over from Elbit's earlier Dust-Off product, which failed to gain traction.

'The advantage of BrightNite is that you can see everything, no matter the conditions, during the darkest of nights. Plus, you get that low-visibility landing solution,' Russo explained.

'For dust landings, there is that fraction of a second when the helicopter is entering the landing zone and the dust reaches you, and if you lose eye contact with the ground, you have to go around. This gives a pilot that quality symbology with all the data that he needs to fly in and land.'

While acknowledging that similar multi-spectral sensor systems were being developed elsewhere for helicopter operations, Russo argued that Elbit's system was the only end-to-end solution which required no change to the aircraft's existing systems or software.

Certainly the feedback from the pilots involved in the demonstration appeared to be positive. The head of one Eastern European air force told *DH* that the system had far exceeded his expectations and would change what was operationally possible during the darkest of nights.

'We haven't changed the philosophy of night flying since the 1980s, when the first NVGs were introduced. This is a breakthrough system that changes that flight philosophy, it opens a whole new world of flight operations arena... The system is like magic.' ■

ON ROCKY GROUND

Agusta-Bell supplied over 70 helicopters (AB205, AB206 and AB212) during the 1970s and 1980s. (All photos: author)

Helicopters are crucial for navigating the rough and mountainous terrain of the Sahara and Atlas, but modernisation of the Royal Moroccan Air Force fleet has long been overlooked. Signs are now emerging that some well-overdue attention may be on its way. **By Alan Warnes**

Rotorcraft are the poor relations of the Royal Moroccan Air Force (RMAF). Unlike the other commands flying fighters, trainers and transport aircraft, the rotary fleet has not seen much modernisation in recent years.

Most of the 70-strong platforms are over 30 years old and obsolete, and there are definitely no glass cockpits within the fleet. Nevertheless, rotorcraft are regularly deployed on operations in the southwest, working with the army in the Sahara.

There is also some evidence that the RMAF may now be receiving some much-needed investment for its ageing helicopter fleet. The Polisario Front, which has fought an armed struggle in the region, is a constant thorn in the government's side. It has campaigned for an independent homeland for the Sahrawi people ousted from the annexed Western Sahara, and troubles still continue sporadically today.

Civil disturbances are not rare, and the Moroccan government is sensitive to criticism. Neighbouring Algeria,

which has supported the Polisario in the past, is viewed with suspicion.

The Bell 205s, SA330L Pumas and recently acquired CH-47Ds are kept active transporting troops around Morocco, which has always had a strong military. Back in 1972, a coup led by the army's Gen Mohamed Oufkir proved it had become too strong, though it was eventually thwarted. The RMAF played a major part in the attempted overthrow, and although all supporters were purged from the military, the monarchy continued to view the RMAF with a sense of mistrust.

Investment era

After the death of King Hassan II in July 1999, his son was crowned King Mohammed VI. The 26-year-old, who had served in the Royal Moroccan Army, gradually changed attitudes, and the current RMAF Commander, Gen Ahmed Boutaleb, appointed on 13 May 1999, has obviously remained a loyal servant.

Comfortable with the RMAF's leadership, the new king set about sanctioning much-needed investment, even if most of that money has bypassed the helicopter fleet. Nevertheless, as long as obsolescence is not hindering the effectiveness of the air force, then it is not an issue for most Moroccans.

When Morocco bought 24 brand-new F-16C/D Block 52s for $2.4 billion, with modern technologies and glass cockpits in 2009, the next priority seemed to be a new lead-in fighter trainer, and indeed, along came 24 Hawker Beechcraft T-6Cs for $185 million.

When the C-130's modular air fire-fighting system was deemed dangerous, five Bombardier 415s were purchased in 2011 at around $200 million. Moreover, with the C-130H tactical airlifter fleet starting to age, four C-27Js were bought to take some of the strain. However, when the RMAF grounded its CH-47C fleet in 2011, there was no quick fix, and the need to lift heavy, outsized loads for the military was lost for a while.

Proposals for the $134 million acquisition from the US government were first notified to Congress on 26 October 2009, but due to Moroccan budget constraints, the purchase was delayed until mid-2014.

Three ex-US Army National Guard CH-47Ds acquired through the FMS programme were flown to Oregon-based Columbia Helicopters on 11-13 August 2014. Reputedly worth $6 million, the contract saw the company overhaul the aircraft and ship them to Morocco, where they arrived in August 2015.

While the aircraft were worked on, pilots and technicians trained at Fort Indiantown Gap, the home to the US Army's Eastern Army National Guard Aviation Training Site. The aircrews and ground technicians spent six months there during the winter. 'It was very cold and we ate a lot,' one Chinook technician who worked on the CH-47Cs, told *DH*.

The CH-47Ds are used primarily to transport troops and underslung oversized loads, although the FMS deal also cited humanitarian requirements. As most of the pilots had previously flown the CH-47Cs, the RMAF had the tactical experience of operating such a large platform. The aircraft operates with two pilots, with at least one engineer and loadmaster.

The CH-47Ds have been operated by the Escadron Chinook at Rabat-Sale since August 2015. These heavy-lift helicopters can transport the eight AN/MPQ-64F1 Sentinel radars requested by ThalesRaytheonSystems in 2011. As part of the RMAF's innovative network-centric air defence system, the Sentinel M1152 HMMWV-based systems need to be moved, often quickly, to locations along the eastern and southern edges of the border.

Seven of the original 12 CH-47Cs, built under licence by Meridionali and delivered from 1978, are grounded and stored without any rotors, according to a local source, and their fate is unclear. While the Chinooks represent the most modern helicopters in the fleet, the rest can be traced back to the 1960s and 1970s.

Tactical training

Training is carried out at 1 BAFRA (Air Force Base), Rabat-Sale, where student pilots will fly around 90 sorties (120 hours) on the survivors of 23 Bell 206A/Bs delivered between 1975 and 1982. Qualified ▶

instructors at the Ecole de Spécialisation Hélicoptères (Helicopter School) teach the pilots the basics of flying a helicopter, after they have flown 145 hours on the AS202 Bravo and T-6C at the RMAF's Flying Training Wing, housed in Marrakesh.

All the RMAF helicopter squadrons are based at Rabat-Sale, although there are a number of forward-operating bases. After the Bell 206s, there are several options including the AB205, SA330L Puma, SA342L Gazelle or CH-47D Chinook. Pilots also spend time with the Centre d'Instruction des Equipages d'Helicopteres (Helicopter Crew Training Centre) at Rabat-Sale, where they learn the tactical aspects of flying before joining an operational unit.

Usually the new aviators head to the smaller AB205 or SA342L to build up their experience, initially as a co-pilot and then as a pilot, before heading to the twin-engined Puma or Chinook. Those flying the Chinook must be highly skilled because of the tough work the helicopter undertakes. Primarily, the pilots are taught how to read and understand the terrain of the country.

A Bell 205 pilot explained to *DH*: 'Unlike some of the other roles, RMAF helicopter pilots have to be versatile. They have to fulfil tactical transport and combat missions. We can be tasked to attack enemy vehicles, or transport personnel and equipment in evolving circumstances, sometimes during humanitarian relief efforts. Recognising and understanding the difficult Moroccan terrain is one of the first things we are taught.

'Often, helicopters such as AB205s, SA342Ls or SA330Ls are formed into flights to escort and protect ground units against the enemy, and are also tasked to go on intelligence-gathering missions in hostile areas.' The 205 pilot said that peacetime missions could include medevac, SAR and the transportation of personnel or equipment.

'It is usually the only option for supporting missions in difficult mountainous areas. The helicopter is the main tool for transporting personnel to carry out maintenance of telecommunication networks and radars. Other general missions include locust control and assisting in relief efforts during natural disasters.'

In late 2014, southern Morocco was hit by torrential rain which caused flooding in the regions of Guelmim, Tan Tan, Haouza, Sidi Ifni, Bouizakarne, Mireleft and Ouarzazate. This led to the deployment of Pumas and AB205s from 21 November to 3 December into the affected areas, to provide humanitarian and disaster relief. More than 145 rescues and evacuations of people in difficulty were performed by these helicopters. They also distributed over 50,000kg of food.

Purchased in the late 1960s, the AB205s continue to prove their worth, with duties as diverse as airlifting soldiers and locust control. Fitted with spray bars on either side of the cabin, where the barrels of insecticide are housed, the AB205s have helped to control the menace of locusts and stem their prolific advance.

The backbone of the RMAF's helicopter fleet is undoubtedly the SA330L Puma, which has been serving since 1974, when the first of 32 were delivered. They were initially delivered as civilian export SA330Fs, but over the intervening years, which have also seen their numbers decrease through accidents, they have been upgraded to SA330L with composite blades.

The Puma's main role is to transport cargo and soldiers, but they are also involved in SAR. They can be armed with machine guns when the need arises, like the AB205s, although no one will discuss this role. ▶

Locusts can be a real problem in Morocco, which has led to several of the AB205s being utilised for insecticide spraying.

RMAF helicopters

Type	Notes
AB205	48 delivered from 1968 onwards, around 15 now operational.
AB206A/B	23 delivered from 1976, around ten are still thought to be flying.
SA330L Puma	32 delivered from 1974, 20 are still believed to be operational.
SA342L Gazelle	24 delivered from 1982, around 12 still flying.
CH-47D Chinook	Three delivered in August 2015, all flying. There are seven CH-47Cs stored.

NAVAL AVIATION

Three AS565MB Panthers are operated by 11F of the Royal Moroccan Navy at Casablanca and are the only helicopters flown by the service. According to one naval officer, it is likely that several bigger platforms will be purchased in the future to assist in transporting personnel from land to ship. A fixed-wing aircraft could also be on the procurement list.

The Panthers deploy on board one of the seven frigates the navy operates. There are three SIGMA vessels, *Tarik Ben Ziyad*, *Sultan Houlay Ismail* and *Allal Ben Abdullah* and two surveillance frigates, *Mohammed V* and *Hassan II*. The newest is a DCNS FREMM class, named *Mohammed VI*.

The three helicopters are used for a multitude of roles, which include: anti-shipping; SAR; delivery of supplies; medevac; transportation of special forces; and surveillance, as they are fitted with a FLIR. So, it is no surprise that more helicopters are required. The pilots train at Dax in France.

GENDARMERIE FLEET

Such is the importance of helicopters to Morocco's Gendarmerie that there are a staggering 13 different types making up its 30-strong fleet. They comprise: SE3130 Alouette II (five), SA316B Alouette III (one), EC135 (three), EC145 (two), EC225LP (one), SA315 Lama (two), AS332L2 (one), SA342K (four), AS355F1 Fennec (two), AS365N Dauphin (four), AS550A2 (four) and S-70 (two).

The Gendarmerie usually covers civil emergencies, at sea, on the road and in the mountains. Its responsibilities are country-wide, although most of the helicopters are based at Rabat-Sale.

The three EC135s can handle two stretchers and carry a maximum of six passengers. They can also be equipped with an SX-16 NightSun FLIR, which can be switched between EC145s. They have been in service for around five years, and while they are predominantly used for medevac, with road accidents the most common requirement, they can also fly VIPs. The two twin-engine EC145s can carry eight passengers, but importantly, they can be used for SAR at sea, and are therefore equipped with flotation gear. They are NVG-compatible.

The AS355s are predominantly used for surveillance and observation, and are equipped with the Sagem LEO II EO/IR turret. Four ex-Republic of Singapore Air Force AS550A2s were acquired in 2011-2012, and are assumed to fulfil a similar role to the AS355s.

The SA330Ls can carry six civilians or four nurses for medevac and can be used for SAR at sea and over land. Fire-fighting is another role, which will see them fitted with a 1,555l Bambi bucket.

Alouette IIs and possibly the SA315 Lamas are used for basic helicopter training at Rabat-Sale. Students then move on to the SA342K Gazelle before progressing to the many other options available there.

While the Alouette II/III, SA315, AS365, AS550 and SA342Ks are based at Rabat-Sale, the operational helicopters are located at Rabat-Souissi with detachments all over Morocco including Agadir, Dakhla, Marrakesh and Tangier.

One SA330L was lost in the Guelmim area of Southwest Morocco, on what is believed to have been an operational support mission on 11 November 2012. It claimed the lives of nine of the 11 people on board but the cause was never revealed.

Pilot programme

It is quite surprising, given that there are over 150 military helicopters flying in Morocco, that there is no central flying school such as that operated by the UK. All three services – air force, Gendarmerie and navy – train their pilots at different locations. Interestingly, the air force and Gendarmerie training squadrons are based at the same location.

The RMAF trains students on Bell 205s and the Gendarmerie on Alouette IIs and SA342s at Rabat-Sale. It seems the inter-service training system which exists in France, Germany and the UK is not practised in Morocco.

There is now a programme in place looking to replace the RMAF's fleet of SA342Ls, first delivered in 1982. The aircraft has provided the RMAF with a light support and limited attack capability, playing an active role in operations in the south west of the country.

France's Aerotech Group exhibited an upgraded SA341F at the International Marrakesh Air Show in April 2014, which would have catapulted the RMAF's Gazelle fleet into a new era.

The 'Naja' programme equips the Gazelle with new-generation weapons and was witnessed at the event with two Raytheon Griffin laser-guided missiles on one side, while the starboard side saw another option – the TDA 68mm laser-guided rocket. An FN Herstal .50cal gun was also exhibited.

While Tunisia and Niger are known to have taken up an upgrade on their Gazelle fleets, and the Iraqi platforms were also worked on before delivery, Morocco did not take this step. Aerotech did, however, fit a pair of night vision lights under the cabin of some of the RMAF's Gazelles.

At the 2016 show, Bell Helicopter believed it was well positioned to provide a solution for replacing the Gazelle. At the 27-30 April event, Stephen Suttles, VP for Middle East and Africa at the OEM, told *DH* that the company was listening to understand what the RMAF needs.

'We think we have the right mix for Morocco and it wouldn't be necessary to replace one aircraft with another,' he explained.

'Working with NorthStar Aviation, we can offer the armed Bell 407MRH, which the UAE [Air Force] is operating. It can be armed with several offensive options – including AGM-114 Hellfire, M134 mini-gun, GAU-19 machine gun and Hydra 70 rockets – to meet their needs.' NorthStar takes the 'green' Bell 407 aircraft to its facilities in Melbourne, Florida, and then integrates the systems the customer requires and ships it to the country.

The company has an office in Abu Dhabi which is working with the UAE helicopters. It was noticeable that the UAE's Bell 407MRH in the Marrakesh static was fitted with an IR suppressor over the engine exhaust. According to the UAE Air Force pilots, this is a new modification, obviously in light of their operations in Yemen and a SAM IR threat.

Bell's other two options are the AH-1Z Viper and UH-1Y Venom, both of which also have an impressive ISTAR capability. 'If they want interoperability with the US and NATO, these two platforms will give us an edge in any competition,' said Aaron Camele, Bell's international military campaign manager.

Bell is also working with NorthStar on an armed Bell 429, which with two engines and increased maximum take-off weight could be an even better – if a more expensive – solution. Neither Airbus Helicopters nor Leonardo Helicopters were at the show to provide their insight into what their options could be, but undoubtedly the H145M or AW149 would be among them.

It seems that finally, the RMAF might be getting some much-needed investment for its ageing helicopter fleet. With that being said, it might even support any coalition fight against terrorism as the F-16s already are in Yemen, adding to the many roles the force already fulfils. ■

Lt Cdr James Taylor, senior observer of 849 Naval Air Squadron, spoke to Richard Scott about the Sea King ASaC7's final years of operation with the Royal Navy, and the planned transition to the Merlin-hosted Crowsnest mission package.

SKASaC sundown

At the end of March this year, the Royal Navy (RN) bade farewell to the Sea King HC4 amphibious support helicopter, having marked the retirement of the Sea King HU5 in the SAR role just three months previously. This leaves 849 Naval Air Squadron (NAS), based at RNAS Culdrose, Cornwall, operating the UK military's last frontline Sea King variant – the ASaC7 airborne surveillance and control helicopter (SKASaC).

It had long been planned that the SKASaC – known colloquially as the 'bag' due to the distinctive appearance of its large radome – would also retire at the end of March 2016, under the MoD's overarching Rotary Wing Strategy.

In the event, the decision was taken in early 2014 to keep seven Sea King ASaC7 helicopters in service, and continue operational flying with 849 NAS until September 2018. This reprieve, and the subsequent decision to bring forward the in-service date for the replacement Crowsnest ASaC mission package, is intended to all but close the gap between the retirement of the SKASaC and the introduction of the Crowsnest for the Merlin HM2.

While the Sea King ASaC7 is now entering its sunset years, it would be wrong to think that the SKASaC force is winding down. 'Since the enduring commitment to Operation *Herrick* in Afghanistan ended in July 2014, the force has focused on regenerating core maritime operating expertise,' said Taylor.

'Everything we're doing has the *Queen Elizabeth*-class carriers and Crowsnest at the end of it. At the same time, we have streamlined and re-brigaded the force into a single squadron, with an HQ and parenting function [overseeing UK-based operations and management] and three deployable flights.'

Bang for buck

Under this reorganisation, the two previous standalone frontline units – 854 NAS and 857 NAS – have been decommissioned. Instead, 849 NAS now parents three operational flights – Okinawa, Palembang and Normandy – named after the squadron's World War II battle honours.

'Of the seven SKASaC helicopters, two aircraft are currently forward-deployed on operations,' said Taylor. 'Three aircraft are available for tasking and training from the UK, one is in modification and one is in deep maintenance. The "bag" is all about bang for buck. We operate a very small number of aircraft, but we make a massive difference.'

Since departing Afghanistan in 2014, the SKASaC force has been operating in the Gulf in support of Operation *Kipion*, the RN's enduring maritime presence 'east of Suez'. Forward deployed to Al Minhad Air Base in the UAE, the three operational flights rotate in-theatre at three-month intervals, with a seven- to ten-day handover in between.

'We've got a permanent presence in the Gulf, contributing to operations and feeding our product into our US and coalition partners through the UK Maritime Component Commander,' said Taylor.

'But alongside this, we are trying to maintain our focus on the return to carrier strike. We are trying to get the flight out at Minhad on board [RFA] *Fort Victoria* for much of the time. So it's a balance between contributing to the *Kipion* tasking and the strategic picture out in the region, but at the same time [finding out] what we can do at a tactical and operational level to really grow our maritime capability and expertise.'

Added benefits

Through its presence in the region, the forward-deployed flight is contributing to the intelligence feed into US Naval Forces Central Command. 'On a local basis, we are identifying anything we can do to add to it,' Taylor said. 'For example, we got some training with the French carrier strike group earlier this year. And we always try to feed into US carrier battle groups when they come through.'

Back at Culdrose, 849 HQ flight is leading on tactical development for carrier strike. 'It's all about growing maritime suitably qualified and experienced personnel,' said Taylor. 'In Afghanistan the focus was, of course, all on land. We're now getting back to ADEXs [air defence exercises] and maritime tactics.

'For example, we've been working with fourth-generation fighters in the Netherlands [Leeuwarden-based F-16s] and France [naval Rafales from Landivisiau] in a series of exercises we call *Skinners Gold*. This is fighter controller force generation training in a coalition environment. We want to get awareness and tactics up to speed to ensure a smooth transition when the F-35 enters service.'

As for the future, 849 NAS will become part of the Merlin force with the retirement of the SKASaC and attendant introduction of the Crowsnest system. 'The Thales [Crowsnest] radar and mission system will build on SKASaC, but there will be a number of improvements,' said Taylor. 'For example, the introduction of ISAR/SAR radar modes, SATURN radios, integrated AIS and integrated ESM. Under current plans, Crowsnest's in-service date is scheduled for October 2018. Initial operating capability will follow in Q3 of 2019, with full operating capability achieved in Q3 of 2021.' ■

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